THE PREPARATION AND AFTER-TREATMENT OF SECTION CASES

W. J. STEWART McKAY

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BY THE SAME AUTHOR.

LAWSON TAIT'S PERINEAL OPERATIONS, WITH AN ESSAY ON CURETTAGE OF THE UTERUS.

With 16 Illustrations. Preface by LAWSON TAIT.

THE HISTORY OF ANCIENT GYNÆCOLOGY.

THE

PREPARATION AND AFTER-TREATMENT

OF

SECTION CASES

BY

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OBSTETRICAL SOCIETY OF LONDON

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1905

DEDICATED TO

THE SISTERS

OF THE

LEWISHAM HOSPITAL FOR WOMEN, SYDNEY,

IN ADMIRATION OF THEIR SKILL IN NURSING

AND THEIR DEVOTION TO THE SICK.

INTRODUCTION

I HAVE been privileged to read the proofs of this book whilst it was going through the press, and have done so with the keenest pleasure. It is over thirteen years since the author and I worked together under the late Mr. Lawson Tait, to whose teaching we both owe so much. The author is a cosmopolitan student of gynæcology, and has visited the leading Continental schools in search of knowledge and improved technique. He brings to his subject, not only a very large personal experience as an operator, but also an intimacy with the best Continental methods and literature. In this volume he has sifted with discrimination the grain from the chaff. I feel sure that all who practise abdominal surgery will welcome it, and learn much, as I have done, from its perusal.

CHRISTOPHER MARTIN.

BIRMINGHAM,
December, 1904.

THE OLD ORDER.

'The operating-table was of wood and of fabulous age. It was sometimes thought necessary to have a new mattress for this table, when the stuffing was found to be matted together in lumps by the blood, which had, during many years, soaked through its covering. The only correct garb of the surgeon was a frock-coat (the oldest and shabbiest in his wardrobe), which was kept in the surgeon's room and never renewed or cleaned during his twenty years of operative work. The operating-theatre attendant was permitted to employ his spare time in the post-mortem room; the surgeons came straight from the dissecting-room to operate, after simply washing their hands; ligatures were used which had been already soiled by handling with blood-stained fingers to sew up wounds in a second case.' —Sir James Simpson.

'As I have said in public more than once, I left Edinburgh with at least one conclusion determined in my mind—that I would never deliberately open the abdomen. The results I had seen in Edinburgh were truly awful—some thirty cases and not a recovery.'—Lawson Tait.

THE NEW ORDER.

'One hundred and thirty-nine consecutive ovariotomies without a death.'—Lawson Tait, *Brit. Med. Journ.*, May, 1886.

PREFACE

In the following pages I have endeavoured to write an account of the methods that should be adopted in preparing for an abdominal section, and I have then considered at length the treatment to be followed after the operation is completed.

My object in writing this treatise has been to endeavour to make things easier for others who are beginning section work; and remembering my own initial difficulties, I hope that I have done something towards lessening the preliminary toubles of others.

I have long felt that the instructions given in text-books with regard to the preparations and the after-treatment of section cases were not full enough for the man who has little experience in abdominal surgery. I have, therefore, set down in the following pages anything and everything that I consider will be a help to the young surgeon.

The notes upon which this book is founded were commenced some ten years ago, when I had the good fortune to be an assistant to the late Mr. Lawson Tait. On leaving Birmingham, Mr. Tait advised me to see the work of the best European surgeons; consequently, I visited some thirty different clinics on the Continent, and made notes on preparatory methods and after-treatment.

On returning to Australia, I was appointed to the Lewisham Hospital for Women and Children, a large hospital near the city of Sydney, and after completing my first hundred sections, I drew up the outline of this essay; and as year after year

passed by, my work at Lewisham enabled me to alter and add to what I had sketched out, until it has finally taken the form set forth in the following pages.

Whilst studying the works of ancient writers on medicine and surgery, with a view to writing my 'History of Ancient Gynæcology,' it became evident to me that the ancient physicians and surgeons were accustomed to sit down by their patients' bedside and watch their cases very attentively, and it is for this reason that they have left us so many graphic and inimitable word-pictures of their patients' sufferings.

I have followed their example, for I have not been content to perform my operations, and then leave my patients for many hours before I returned to them. I have made it a practice to see my serious section cases every six hours until all danger was passed, and I have often remained with them for many hours during a crisis. My object has been to SEE for myself, not to be content with the telephone report of even a watchful and devoted nurse. Any merit that the third part of this work may have rests on this practice of sitting down and studying face to face every complication that has arisen.

Naturally, then, I am in entire agreement with Howard Kelly when he says: 'That surgeon will best differentiate his cases who unremittingly watches every symptom of the early convalescence, and proceeds at once to meet any complication that may arise.'

As my experience has been rather more extensive in pelvic surgery than in the wider field embraced by the term 'abdominal surgery,' the examples of the complications met with after cœliotomy have been, as a rule, chosen from gynæcological cases.

In choosing these cases, I have quoted examples from the writings of others in preference to my own cases when I thought them more apropos; but I have always quoted my own failures when they taught a lesson.

I am afraid that I have been prolix, but I hope my *facts* are

not often false. If my *views* prove false little harm will result, for, as Darwin observes, 'False views, if supported by some evidence, do little harm, for everyone takes a salutary pleasure in proving their falseness; and when this is done, one path towards error is closed, and the road to truth is often at the same time opened.'

I wish to thank my colleague, Dr. Burfitt, for having read the whole work through, and for his judicious advice on some passages; also Dr. Herbert Child, who has kindly assisted Dr. Christopher Martin in the arduous task of passing proofs through the press.

My thanks are also due to Miss Lewington for the accurate manner in which she calligraphed the whole work, and to Messrs. Baillière, Tindall and Cox, Arnold and Sons, The Kny-Scheerer Company, Down Brothers, and Maw, Son, and Sons, for having lent me numerous blocks, illustrating instruments and other apparatus.

W. J. STEWART McKAY.

SYDNEY,
October, 1904.

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Omission of Figs. 67 to 87.—*While the book was passing through the press it was decided not to insert these figures of instruments, as being unnecessary.*—Ed.

THE PREPARATION AND AFTER-TREATMENT OF SECTION CASES

CHAPTER I

INTRODUCTION—THE OPERATING-ROOM AND ITS EQUIPMENT

A SURGEON may be called upon to perform an abdominal section in the theatre of a hospital, at a private nursing 'home,' or at a patient's own residence.

The preparation for an operation at a public or a private hospital being an every-day occurrence, and carried out by a house surgeon or by experienced nurses who have at their command everything they may want, relieves the surgeon's mind of much worry, for he goes to his work with nothing but his hands to prepare.

But sooner or later he will be called upon to perform a section in a private house, when he must use his own instruments, ligatures, and dressings; when he must issue his instructions to his nurses with regard to the preparation of the rooms and the patient; and when he must be prepared to overcome the numerous difficulties that crop up when he is operating in an environment so utterly in contrast to the operating palaces of marble, glass, and steel that are common in all large cities in the present day.

We shall proceed to discuss the details for an operating-room at a private installation, so as to show what surgeons now consider desirable in order to most easily secure uniformly successful results; and we shall then give for contrast the details for the preparation of a woman in a private house where a section has to be performed at short notice. We shall, however, be at pains to show that although the first room is the one that any surgeon

would choose to operate in, yet experience abundantly proves that the most difficult and complicated sections may be successfully dealt with in any clean bedroom.* The specially constructed room is easier to clean and easier to keep clean; but while this is an important point, and tends to secure a successful result, it is, after all, a very insignificant one when compared with the skill of the operator and the aseptic condition of his hands and instruments. Those operators who work in fear and trembling in any room but a specially constructed one should remember that Mr. Tait, who was in his day one of the most successful of operators, performed hundreds of abdominal operations in private houses, and in his private hospital at Birmingham he had no special room to operate in, but always chose the patient's bed-room.

The Operating-Theatre of a Private Hospital.

Aspect.—The aspect of the room is of little consequence provided the light can be admitted from above as well as from the side. In warm climates a western aspect will be excellent for winter and for summer, provided the operations are performed in the early morning; but such a room may be unbearable on a summer afternoon. If the glare in the room be too great, venetian blinds may be placed on the outside (Plate I.) of the windows, to be regulated by cords fixed without or admitted through the window-sash; but it would be a great mistake to have blinds on the inside, since they would become receptacles for dust.

If we are constructing a room specially it would be advisable to have a skylight with a northern aspect, for this insures a good light with but little glare.

Floor.—The floor should be composed of a material which is not hygroscopic, which is hard and even, and which can be easily kept clean.

Tarnier tried various materials in his Maternité in Paris before he was satisfied. His conclusions on the materials for floors were that stone was hygroscopic, and remained damp and cold after being flushed; that slate had the same disadvantages; and that asphalt became softened with the heat and also with the weight of the tables. He was, however,

* 'An evil environment must not be created, but if it exists it can be defied' (Lucas-Championnière).

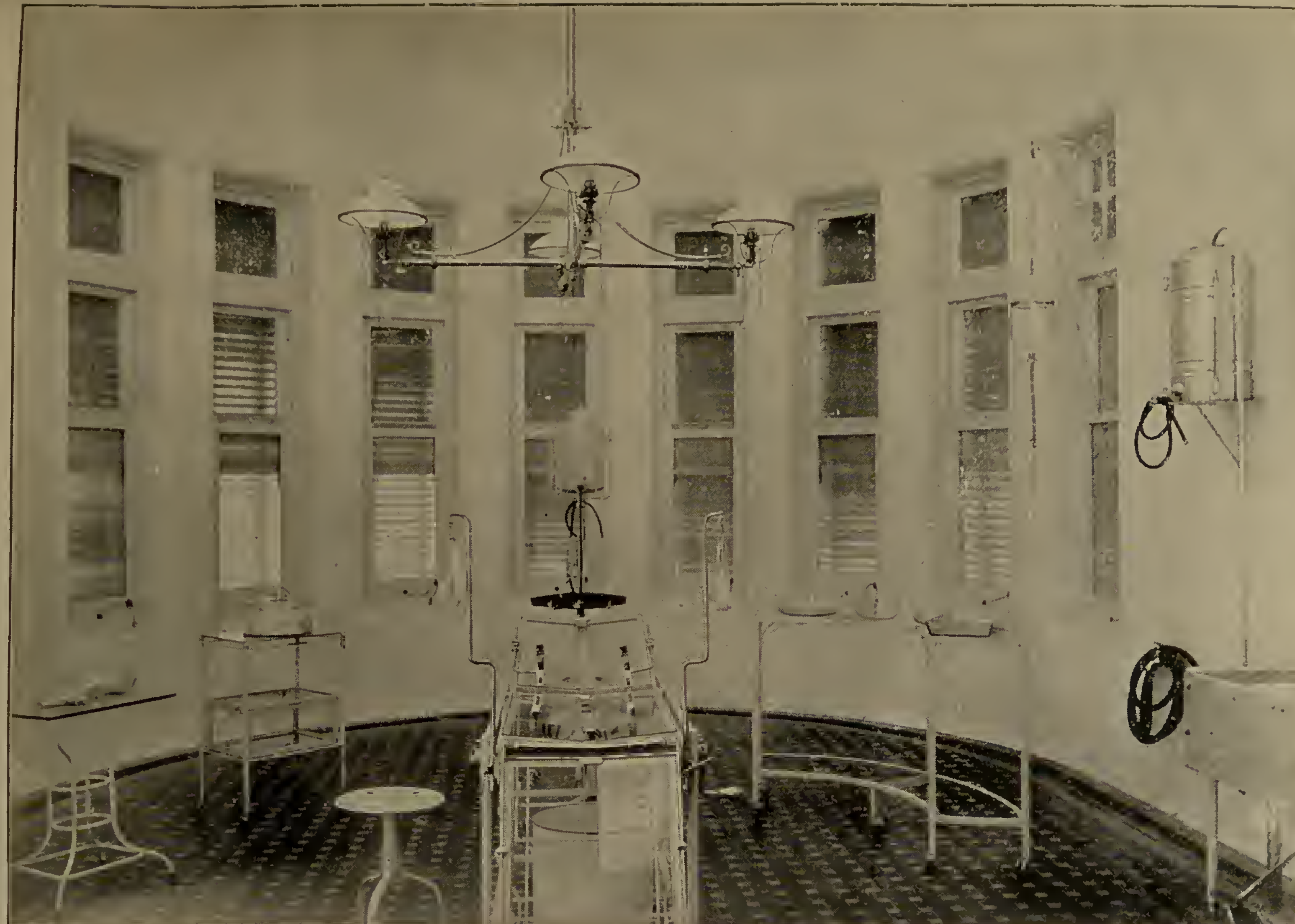

PLATE I.—OPERATION-THEATRE, LEWISHAM HOSPITAL FOR WOMEN, SYDNEY.

Aseptic Fittings by ARNOLD AND SONS, LONDON.

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satisfied with cement, and remarks, 'Le ciment constitue un sol très bon, imperméable, non hygrométrique.' It has, however, one disadvantage—that after a time the superficial layer becomes destroyed and gives rise to a fine dust; yet he thought that but a slight drawback, and it can be remedied by a new superficial coat.

Tarnier was also very satisfied with tiles, and if well laid he does not believe that dirt accumulates in the joints between the various pieces. They have the great advantage of being easily washed and kept clean. He speaks with admiration of the operating-room at Halle, the floor of which is a mosaic; the chief drawback to this, however, is its initial cost.

The conclusions arrived at by this most accurate observer have been abundantly confirmed by others, so that we may say that if expense is no consideration the floor may be of mosaic (*terazzo*) or encaustic tiles; but if economy is desirable, then the floor may be of cement, painted boiler iron, or of polished wood, the spaces between the various pieces being well caulked, like the deck of a yacht, so that no water will soak through to destroy the ceilings below. This was the style of floor that Tait liked best.

Tarnier also praises linoleum, and when it has a high glaze it is an excellent material, and relatively inexpensive. The floor may slope towards the centre of the room, or, better still, towards the walls, round three sides of which an open shallow tile, or lead, or marble drain is constructed (Plate I.).

Walls.—As the walls approach the floor, they should be so sloped as to curve towards the drain (Fig. 1), or a bevelled slab of marble may be introduced so that no angle is formed where the floor and walls meet. The advantage of such an arrangement is obvious, especially when using the hose on the floor and walls.

If the room has a wooden skirting-board the space between this and the floor, if any exist, should be caulked or closed with putty.

As the walls run upwards they should fade into a cupola ceiling so that all angles may be abolished, and thus the walls by a gentle slope will reach the skylight, in which a ventilator or an electric fan is fixed. Some surgeons object to this ventilator, as they maintain that it creates currents and disturbs the dust; but if there is no ventilator, we get conden-

sation on the ceiling and a trickling of the condensed water. Care should be taken that the ventilator is so constructed that in cold weather it will not become an air-shaft for admitting a down current on the operating-table.

In hot climates the ventilator may be worked by a stream of water, which is afterwards distributed over the glass roof of the skylight, and tends to keep it cool in summer.

Though the ventilator may be so constructed that it may be closed if desired, the skylight should be a fixture, for if it is made to open it will only be the means of admitting a cloud of smuts.

In hot climates the glass skylight should have a roll-blind fixed on the roof, so that this may be lowered when required.

FIG. 1.—Diagram to Show the Method of Obliterating the Angle between the Floor F and the Wall W in the Operating-Theatre. D is the open drain that surrounds the theatre.

This will reduce the temperature of the room, and take off the glare from the white walls.

The frames of the doors and windows should be flush with the walls, and anything of the nature of a cornice must be avoided, for such would only be a receptacle for dust, and would act as a storehouse for germs, which would gravitate towards the operating-table on being disturbed by currents of air.

Even with plain varnished walls Esmarch found in a space 225 centimetres square 90 micro-organisms; while in a space 1 centimetre square on a ledge in the same room he found from 650 to 1,350 colonies.

If we are unable to obtain an attic-room for the operating-chamber, the ceiling of the room chosen on a lower floor should be constructed of cement or painted sheets of iron ('Emdeca'), so that it may be hosed and kept clean. Tiles and marble do

PLATE II.—'MARTHA' THEATRE, ST. BARTHOLOMEW'S HOSPITAL.

not make a good ceiling, as the steam in the room rapidly condenses and then drops.

The walls of the room should be composed of some material that can be hosed without the water damaging it. For a space of from 2 to 3 feet from the floor tiles, slabs of Verona marble (Plate II.), or thick glass plates may be carried up the walls so as to form a dado, or the whole wall may be treated with thick, smooth cement, covered by enamel, water proof paint. Macnaughton-Jones says that a lacquered paint made by Messrs. Flicoteaux, Paris, gives a porcelain surface, is capable of being scratched without detriment, and is thoroughly aseptic. The walls of the operating-theatre at the Lewisham Hospital are finished with Keen's white cement, and present a smooth, hard,

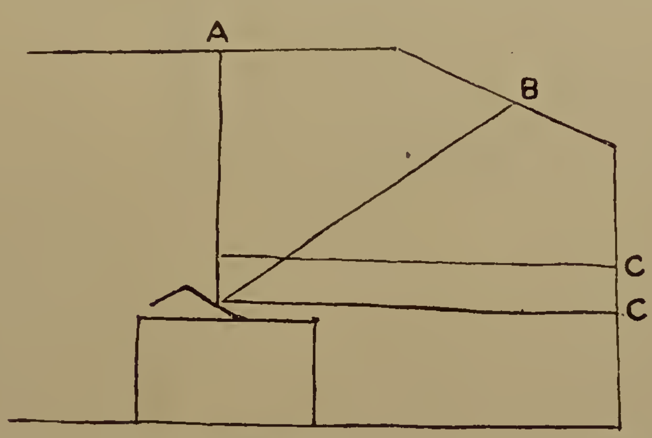

FIG. 2.—Diagram to Show the Three Points (A, B, C) from which Light should be admitted into an Operating Theatre for Pelvic Operations.

polished surface, capable of being hosed without detriment.* These walls are tinted gray, as white is found to be very trying to the eyes in summer weather.

Lighting.—If possible, the chamber should be lighted from above and from the side, the light above being admitted in at least one place, so that the rays will strike the table at an angle of 60° (Plate IV. and Fig. 2).

For artificial illumination the electric light is the best, but as that is not always available, we must resort to gas incandescent burners hung from the ceiling and surrounded by reflectors (Plates II. and III.). As, however, these reflectors act as shelves for dust, and are placed directly over the operating-field, care must be exercised in having them frequently cleaned (Fig. 3).

* The walls of the new gynæcological theatre of the London Hospital are covered with Portland cement, and this is covered with Griffith's 'opalite.'

The electric light has an advantage over gas, for when chloroform is being administered and a gas-jet is alight in the room, those present soon become affected by an irritation in the throat. This is due to the liberation of chlorine, and if the operations are lengthy, the effect is very disagreeable, especially if anyone present is subject to asthma.

FIG. 3.—Chandelier with Pendent Light for Operating-Theatre.

A hand-lamp to be used in connection with direct supply from the electric main is very useful (Fig. 4), and a kerosene lamp, or, better still, an acetylene lamp placed on a movable iron stand behind which is fixed a mirror that can be easily altered so as to throw the light on to the field of operation, will often be found of great assistance; while a small portable battery with an electric

PLATE III.—OPERATION-THEATRE, LEWISHAM HOSPITAL FOR WOMEN, SYDNEY.

Aseptic Fittings by ARNOLD AND SONS, LONDON.

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lamp attached will prove invaluable when searching for a bleeding point in the depths of the pelvis. In order that the operator

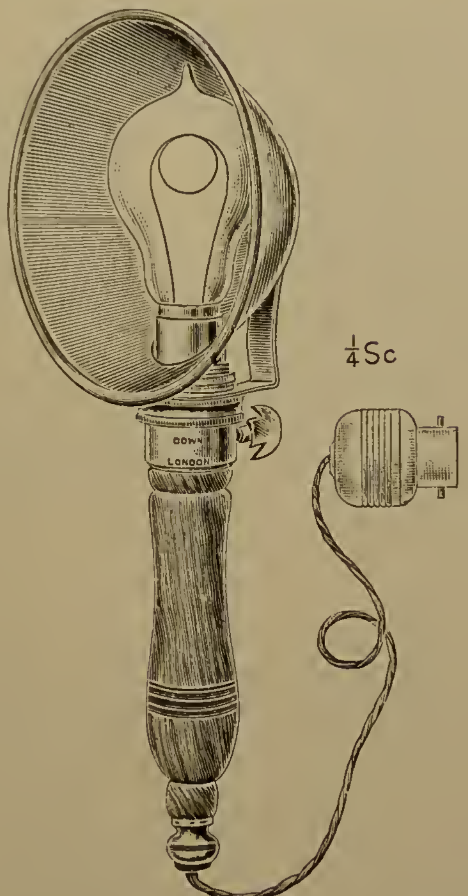

FIG. 4.—Electric Hand-Lamp, to be Used in connection with Direct Supply from Main.

may handle such a light, it should be fixed on a nickel-plated rod, around which a gauze sponge is placed before it is handed

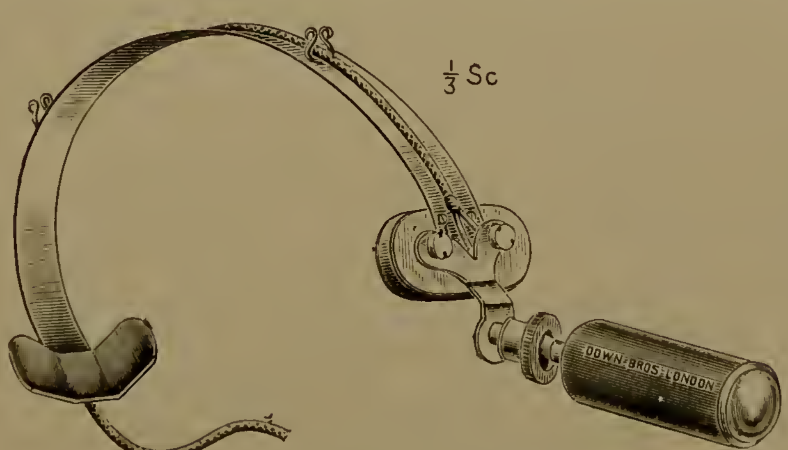

FIG. 5.—Electric Forehead Light.

to the surgeon or his assistant, while the connecting wires should be covered by a few feet of rubber tubing, which if soiled can be

sterilized after every operation. Some operators have the light fixed to their heads (Fig. 5).

Warmth.—In cold climates the operating-room should be heated by hot-water pipes; but if this is not possible, it may be heated by means of a portable gas-stove connected with a flue.

Ventilation.—The currents of air entering the operating chamber should be so regulated that the patient will not be in the least draught during the operation, otherwise she would be chilled, and the wound would be contaminated by the air-borne particles. Air should be freely admitted, but it is well to keep the windows closed overnight, so that no currents of air will

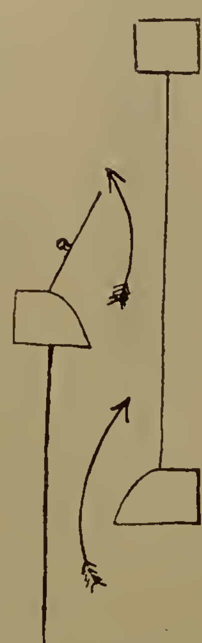

FIG. 6.—Diagram of Windows arranged to Admit Air freely into a Room when the Wooden Shutter is Raised.

interfere with the germs gravitating to the damped floor during the stillness of night.

That the air is a possible source of infection in large public hospitals has been dwelt upon times out of number, for it can easily be shown that after the exposure of gelatine plates in the wards and in the operating theatre for a short period, colonies of bacteria, including the *Staphylococcus pyogenes aureus* and *albus*, are found. The air of a theatre in a private house will probably be comparatively free from pyogenic organisms; in fact, as Schimmelbusch says, the only thing that must be done to avoid a possible infection by the air is to guard against immoderate stirring up of dust in the operating-room.

PLATE IV.—NEW THEATRE, ST. BARTHOLOMEW'S HOSPITAL.

With Aseptic Fittings, etc.

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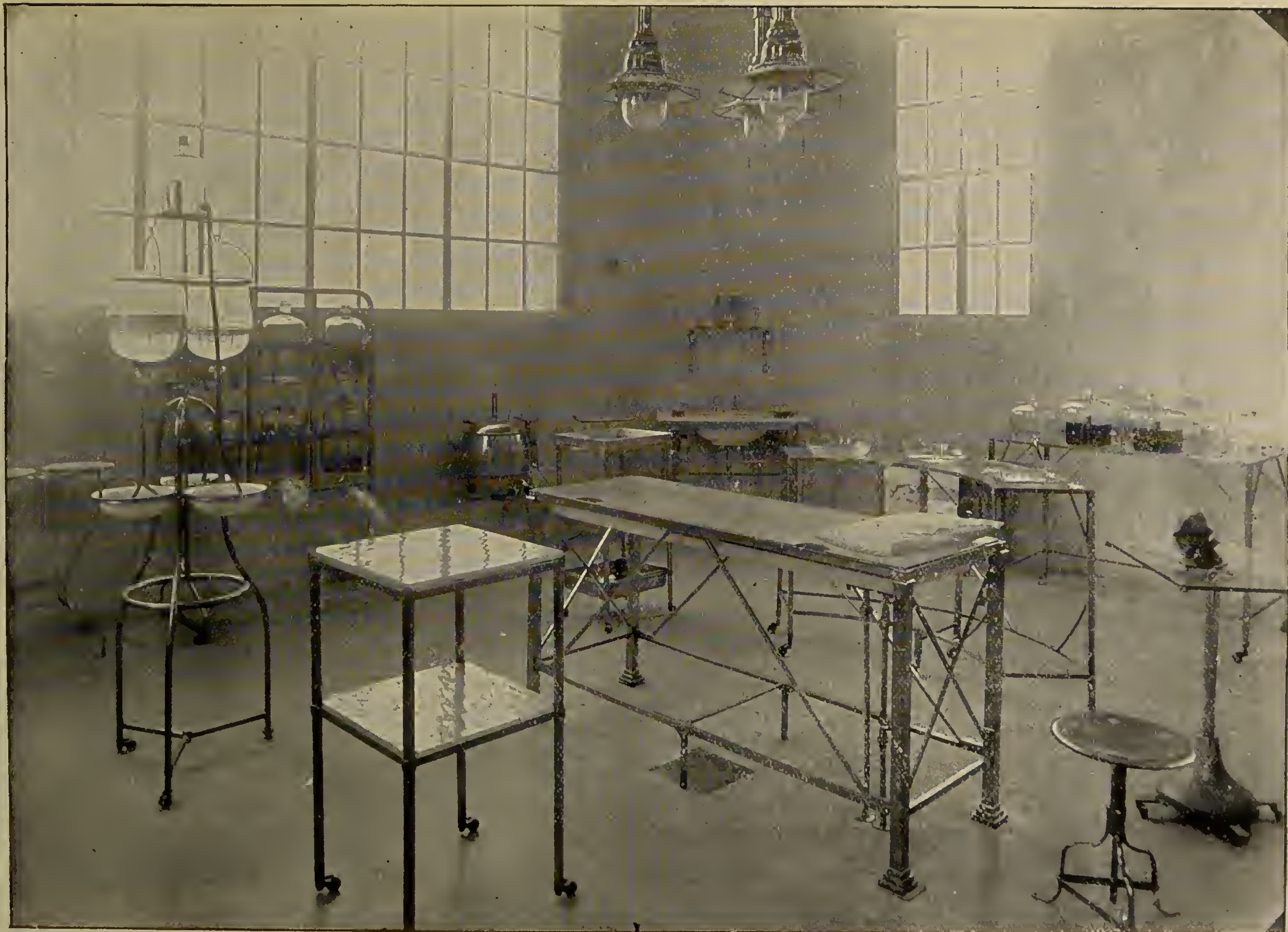

PLATE V.—NEW THEATRE, BRITISH HOSPITAL, BUENOS AYRES.

Air may be freely admitted into an operating-room by a simple arrangement of the windows (Plate I.), as will be seen by referring to the accompanying diagram (Fig. 6).

The upper half of the window descends for about 9 inches below and behind the upper border of the sash of the lower pane. A current of air can thus find its way up into the room without creating a draught. If, however, the day is unusually boisterous or dusty, we close this inlet by a shutter fastened to the sash of the lower pane. As the small glass apartment between the upper and lower panes would in time become a receptacle for dust, we may easily clean it by directing the hose on the upper pane.

Shelves.—Shelves would be conspicuous by their absence. If, however, they are used, they should be constructed of metal brackets supporting a glass slab; the latter can be removed and disinfected with ease.

The Equipment of the Operating-Room.

The contents of an operating-room should be constructed of materials that are easily cleansed (Plate V.) and kept clean, and there should be no hidden parts where filth can gradually accumulate; in fact, every dish, sink, table, or drain should be so constructed that every part can be inspected when being cleansed.

Water-supply and Basins.—For the surgeon the first requisite is an abundant supply of hot and cold sterilized water, and we later on shall fully describe the best means for insuring this supply.

The water having been sterilized in a room adjoining the operating-theatre, is conducted by pipes to the basins. These basins must on no account be fixtures; they must, on the contrary, be placed on pivots in a trough or hopper of enamel, slate, or marble (Plate VI.), so that when the surgeon has used a basin he has merely to tip the edge to cause it to rotate and empty its contents into the wide trough in which the basin is placed; the water then runs to the end of the trough, where a wide, short pipe conducts it to the *open* drain which surrounds the room.

In order that the surgeon may fill the basin with either hot or cold water, two levers are arranged (Plate VI.) on the floor beneath the hopper in such a way that by pressing with the right foot

hot water enters the tube leading to the basin, and by pressing another lever with the left foot cold water enters. Thus the old arrangement of turning on and off a tap with the hand is abolished, and the risk of infecting the surgeon's hands is lessened. In some cases a third lever is added, which, on being

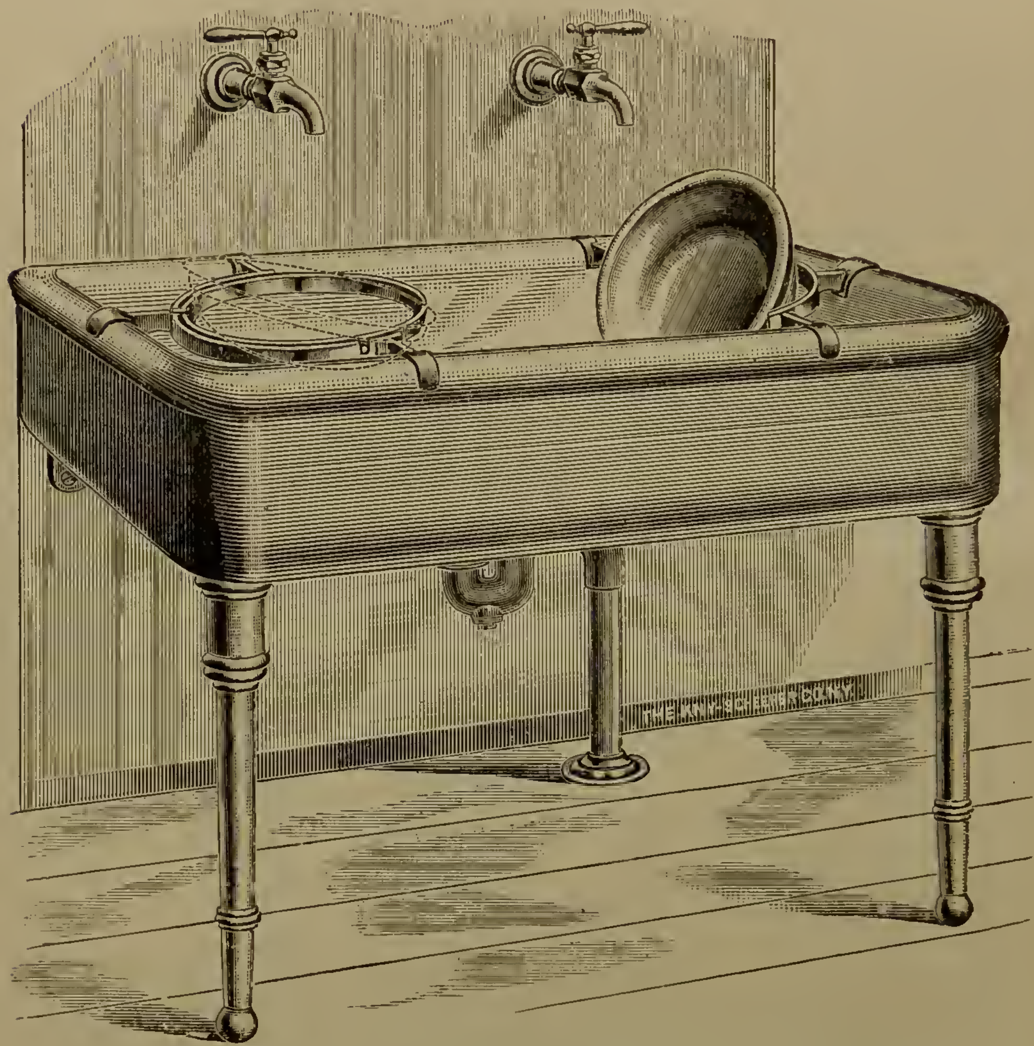

Fig. 7.—Combination Washstand, Porcelain Sink, Two Double Frames with Tilting Basins.

pressed, is so arranged that it will lift the basin, and so even the rim need not be touched by the hand to empty the basin.

A handy basin support, which may be easily applied to any hopper or sink, has been described by Kelly.* It consists of a metal frame with three arms, which are fixed to the sides of the sink (Fig. 7). The frame carries pure nickel basins which can

* Kelly, *American Journal of Obstetrics*, vol. i., p. 188, 1898.

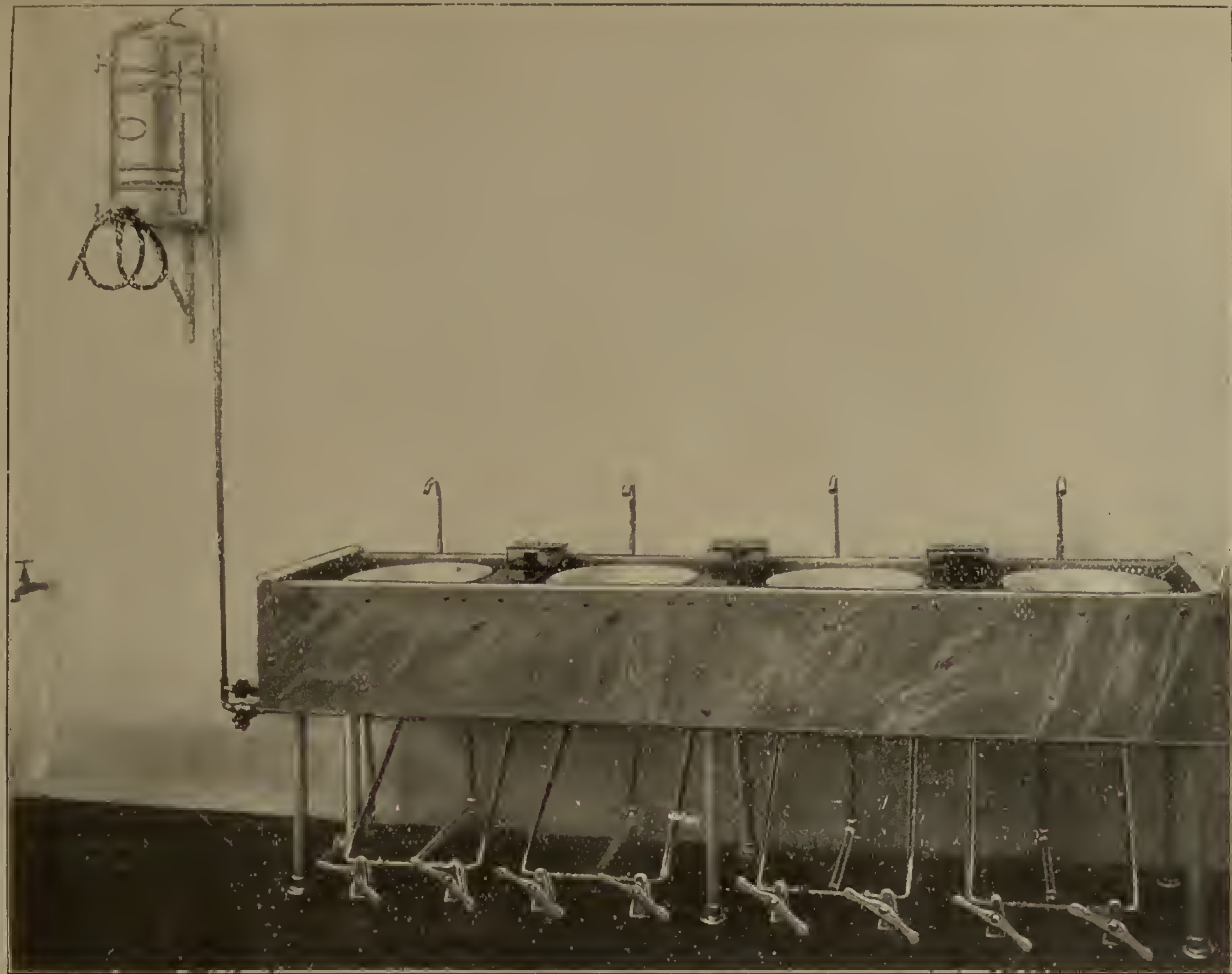

PLATE VI.—REVOLVING NICKEL-PLATED BASINS, BETWEEN WHICH ARE GLASS SLABS TO HOLD SOAP AND BRUSH BOXES.

Marble trough ; hot and cold water, regulated by pedals ; waste-pipe (to left), leading into an open tile-drain ; tap for hose (to left). (Lewisham Hospital, Sydney.)

To face p. 10.

Fig. 8.—Revolving Nickel-plated Basins set in Marble Trough. (Lewisham Hospital, Sydney.)

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be easily tilted, and after being used can be removed and placed in the sterilizer.

A basin that is a fixture is dangerous. Kelly says: 'The fixtures in ordinary use are utterly unfit for the service, and ought to be discarded, for they lodge the filth and grease of vaseline contaminated by various examinations, and cannot be sterilized by any known method. . . . I sincerely trust it will not be long before every surgical clinic in our lands will discard fixed glass and porcelain basins, and substitute in their place metal basins which can be removed and sterilized.'*

In some private clinics on the Continent the basins stand on broad, thick plates of glass let into the walls, and after the basins have been used they are emptied on to the floor.

In place of the hopper and movable basins just described, many surgeons use portable lavabos, consisting of a reservoir containing fluid above a basin connected by a rubber pipe with a bucket. On either side is a small bracket for soap and a nail-brush. Such a lavabo (Plate V.) can be moved readily to any part of the operating-room, and it may be placed close to the surgeon when operating, so that he may turn and rinse his hands. As the basins and reservoir are movable, all parts of the apparatus may be easily sterilized.'

Some lavabos are constructed so as to have several reservoirs and basins; the hands may be washed in one basin and steeped in the disinfecting fluid in another.

Nail-brush.—The nail-brush is an indispensable requisite for every operating chamber, and no surgeon can hope to cleanse his hands and nails properly without a thorough preliminary brushing with soap and water. But inasmuch as the brush itself rapidly becomes septic, it is necessary to purchase only those that can be efficiently disinfected. The backs should be made of wood, and should be in one solid piece, and ought to be 3 or 4 inches in length, so that it may be easily and firmly grasped, while the brush should consist of stiff bristles or vegetable fibre (Figs. 9 and 10). Before using a new brush it should be submitted to steam sterilization for at least half an hour. It may then be dried and kept in a stoppered bottle until required for use, or it may be left to soak in a 5 per cent. carbolic solution or a 1 in 1,000 biniodide of mercury solution. When in use it may be placed in a bowl or square glass box containing one of

* Kelly, *loc. cit.*, p. 193.

the above solutions. After an operation the brush is taken, and the soap, blood, and albuminous matters are washed out of the hairs. This may be done by placing the brush in hot water with some washing-soda or ammonia. After the brush has been well washed it should be placed in a basin of hot soda solution, and allowed to remain there for a few hours. It is then washed

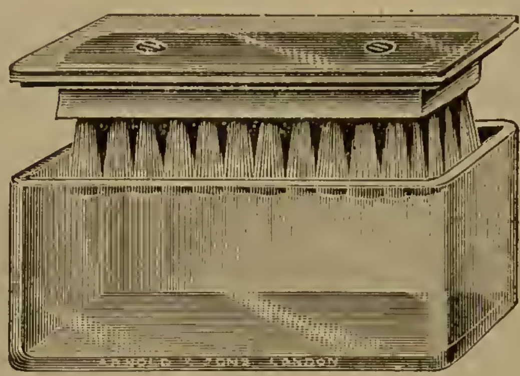


FIG. 9.—Glass Box, with Nail-Brush fixed to Lid.

in sterilized water and disinfected in the steam sterilizer. By placing the brush in solution of permanganate of potash and then in a solution of oxalic acid, the hairs will assume a pleasant, clean appearance, and will be still further disinfected. After being used for some time, the fibres or hairs of the brush will become soft, and the brush must then be discarded.

FIG. 10.—Box for Nail-Brush.

Kelly* says: 'The same brush must never be used by two different persons, or twice by the same person, without re-sterilization. As I visit various clinics, I often see no more serious defect in the technique than the miserable, insignificant, flabby nail-brushes often used by the surgeon and all his assistants in common, without any or with but one sterilization. Scrubbing the hands, and particularly the nails, with such brushes becomes a farce.'

* 'Operative Gynæcology,' vol. i., p. 20.

Soap.—Well-made soap is free from germs, but hastily-manufactured soap may not be aseptic.

But whereas a new cake of soap may be free from germs, if once used by hands containing septic organisms, does the soap become inoculated and septic?

It has been found* that if small slabs of germicidal soap and ordinary toilet soap be taken and heavily inoculated with a culture of *Staphylococcus aureus*, and kept in a moist, hot chamber for two days, at the expiration of that time the surface of brown Windsor, lysol, and germicidal soaps is sterile, but scrapings from other toilet soaps all give rise to growth of the organisms first inoculated. On none of the surfaces is there any apparent increase of growth. In fact, numerous experiments show that it is impossible to grow moulds or bacteria on the surface of soap kept under ordinary conditions.

Thus we see that the organisms which get rubbed into a soap in the process of washing our hands are not capable of multiplication; but since the ordinary toilet soap may be inoculated with virulent germs, if this soap is used the next day there is no reason why we may not inoculate our hands afresh whilst using the soap.

It follows from this that it is safer to use soaps impregnated with antiseptics. But we must not fall into the error of supposing that because these soaps are capable of destroying the germs that are rubbed on to their surface we can effectually disinfect our hands by using these antiseptic soaps. In the one case the germs are placed on the soap, and remain there for many hours; in the other case, when we use these soaps to wash our hands, we are using, for a few minutes, a very weak solution of an antiseptic incorporated with olein, fat, or oil, all of which are vehicles which militate against germicidal action.

Therefore we may conclude that while ordinary brown kitchen soap, green soap, and soaps impregnated with the iodide of mercury all have in themselves some slight antiseptic property which enables them to prevent the growth of or destroy germs left in contact with them for some hours, these soaps are useless when used to **thoroughly** disinfect the hands.

This does not, however, appear to be the case with regard to the officinal soap spirit of the German Pharmacopœia, for Mikulicz has shown that the hands may be disinfected with

* Symes, *Bristol Medico-Chirurgical Journal*, September, 1889.

this soap. It is composed of 6 parts of olive-oil, 7 of caustic potash, 30 of alcohol, and 17 of water.

Experiments with *Staphylococcus aureus* prove that this solution

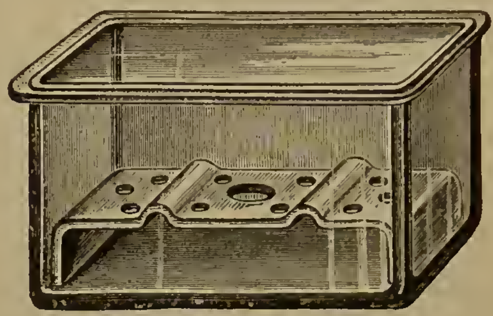


Fig. 11.—Soap-Box.

has a greater sterilizing power than 1 in 1,000 of perchloride of mercury.

The germicidal soap that we have used chiefly is McClintock's, made by Parke, Davis and Co. It does not attack nickel-plated instruments or basins, it does not coagulate albumen, and it has

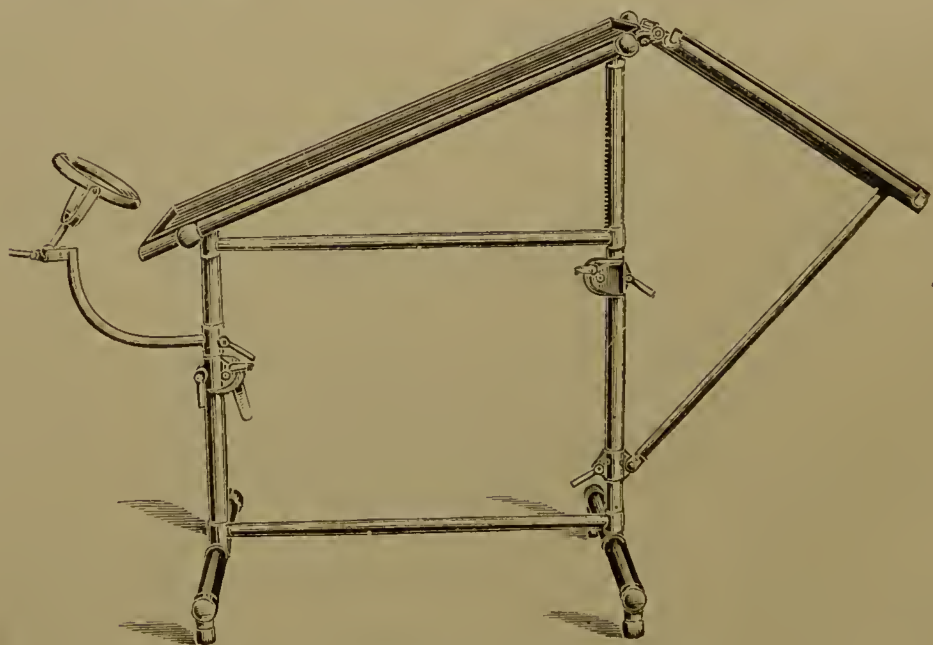


Fig. 12.—Greig Smith's Operating-Table.

very considerable germicidal powers. Nevertheless, we must again repeat that on no account is the surgeon or the nurse to trust to any antiseptic soap for disinfecting the hands.

The soap-box should be of glass, and should be sterilized every day (Fig. 11).

Operating-table.—The best tables are those constructed of nickel and glass. Greig Smith's well-known table (Fig. 12) is a most excellent one, but if the operator uses the Trendelenburg position often, the table should have curved shoulder-pieces attached to it to prevent the patient slipping towards the anæsthetist.

At the Lewisham Hospital Boldt's table, made by Arnold

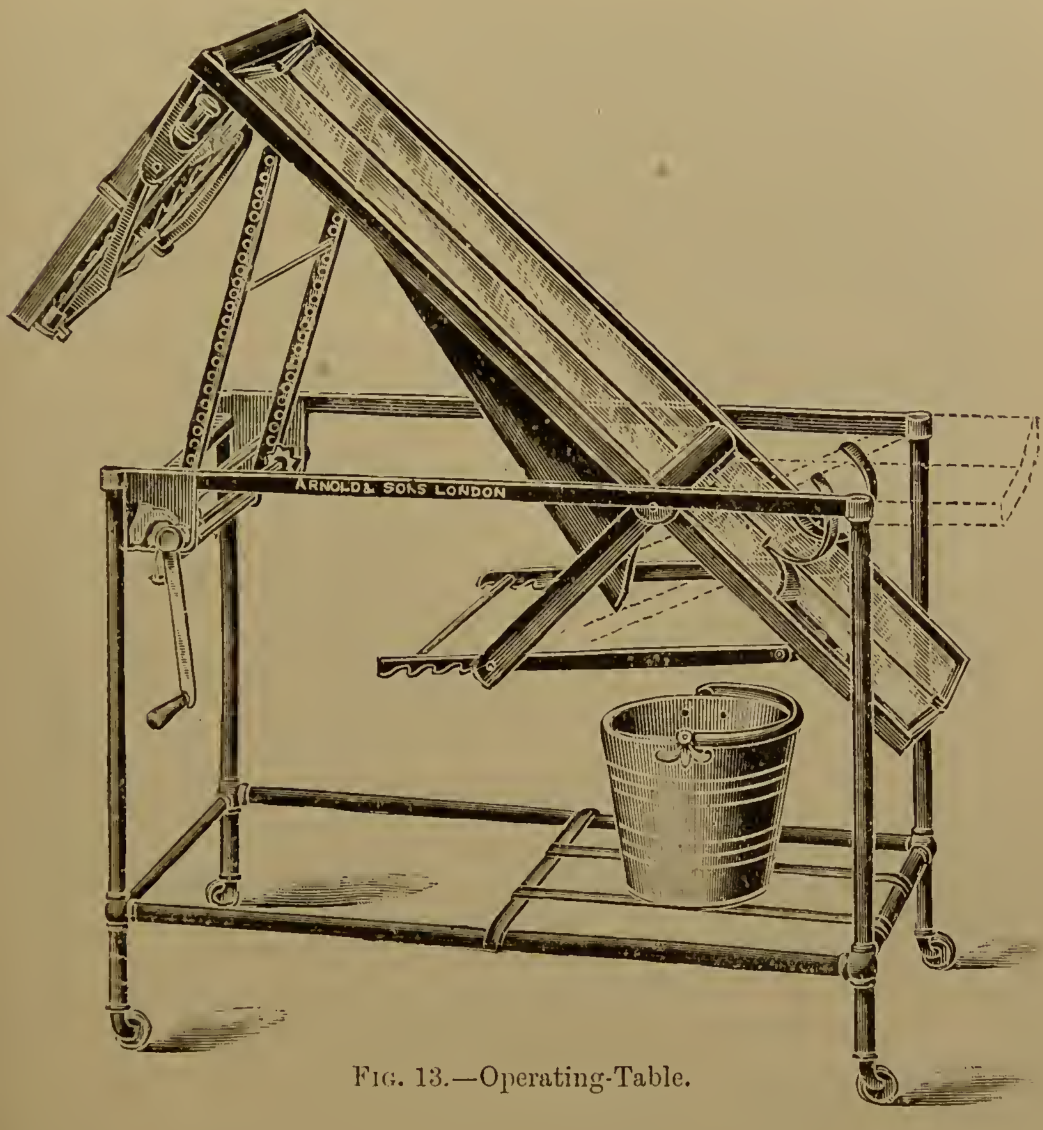


Fig. 13.—Operating-Table.

(Fig. 13), is the one in use, and it cannot be surpassed as a useful table. The patient may be placed in the Trendelenburg position by a few turns of a handle.

As these operating-tables are very expensive items (Arnold's, for instance, costs £30), a wooden table 3 feet 6 inches high and 2 feet wide, to which a portable frame for the Trendelenburg position may be fixed, will suffice. Such a frame may be made

of wood (Fig. 14), and a canvas or waterproof support for the body buttoned to it. When fixed to the wooden table, it is kept in position by two clamps. The table should also have shoulder-rests.

Some surgeons when operating elevate the legs of the patient so much that the patient's body is at an angle of 60° to 75° with the table (Fig. 15). When such an elevation is used, the legs below the knees must be fixed at right angles to the thighs by padded straps, for if the patient's body is allowed to be alone supported by the curved shoulder-pieces, the patient will complain most bitterly for days afterwards of the pain in her neck and shoulders. It is therefore much the better plan to fix the body by means of straps passed in front of the tibiæ and fixed to the short arm of the Trendelenburg frame. Under any circum-

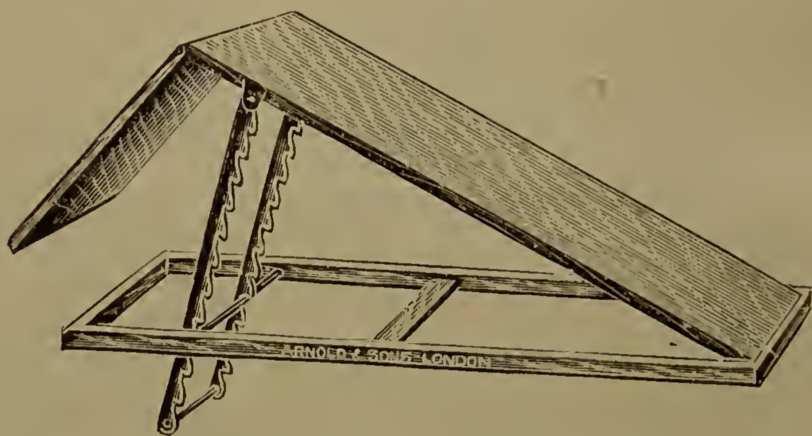


Fig. 14.—Frame for placing Patient in the Trendelenburg Position.

stances, if the shoulder-pieces are used they should be well padded. As a matter of fact, after elevating a patient to an angle of 60° we often find that after the intestines have sunk towards the diaphragm and the sponge cloths have been placed in to isolate the field of operation, we may then lower the patient to an angle of 30°, and the intestines will not return towards the pelvis.

After using the elevated position, care should be taken in lowering the patient to the horizontal position that the arm of the patient is not caught in the descending framework. We have seen the forearm of a young girl jammed almost flat after being caught for a quarter of an hour in Boldt's table.

Tables for Instruments, etc.—Besides the operating-table, several other tables will be required. These tables, when com-

Fig. 15.—Doyen's Operating-Table: Trendelenburg's Position.
(Macnaughton-Jones.)

To face p. 16.

PLATE VII.—OPERATION-THEATRE, ROYAL PORTSMOUTH HOSPITAL.

posed of an iron frame painted with white enamel paint, movable glass tops, and the whole running on rubber rollers, are very graceful, and lend an attractive appearance to the operating-room.

The table for the surgeon's instruments may be oblong or kidney shaped, whilst others to be used for dressings and for the anæsthetist's apparatus will be square, and some may have a second glass shelf below the upper plate. The manner in which these tables are to be arranged in the operating chamber we shall describe in another place.

Glass Jars.—Antiseptic fluids that are to be used by the

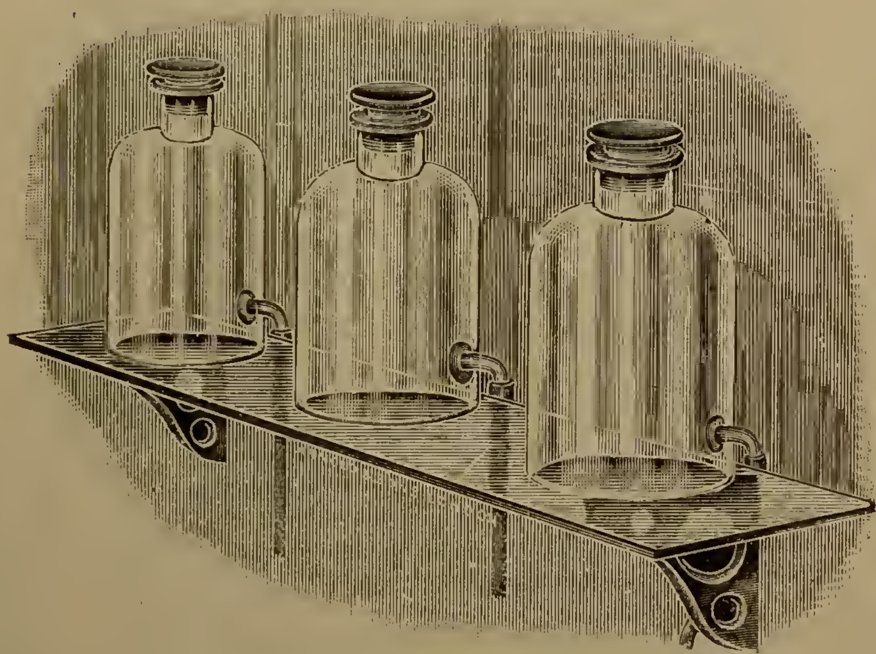


Fig. 16.—Shelf for Bottles with Antiseptic Solutions.

surgeon or the nurse are best kept in glass jars capable of holding two gallons (Fig. 16). These jars may stand on a movable glass shelf (Plate VII.), which is supported by a couple of iron brackets fixed into the walls, whilst the fluids are drawn from them by means of glass taps or rubber tubes closed by a catch. We have at Lewisham four such jars fixed in a metal stand, each jar being supported by a collar, which revolves on pivots, so that the fluid is readily drawn by revolving the whole jar (Fig. 17).

These jars are labelled: Iodic hydrarg., 1 : 500; hydrarg. perchlor., 1 : 500; acid. carbol., 1 : 10; lysol, 1 : 50. The solutions are made up to these strengths so as to allow the addition of warm water.

On another iron frame, designed by Arnold, stand two jars with rubber pipes (Fig. 18). By pressing with the foot on a lever, which is connected with a stop that crosses the rubber pipes, the fluid is permitted to escape into a glass basin immediately below the tubes. One of these jars contains iodic hydrarg. dissolved in methylated spirit (1 in 500), and the other iodic hydrarg. in water (1 in 1,000), and these fluids are used for the final disinfection of the surgeon's hands.

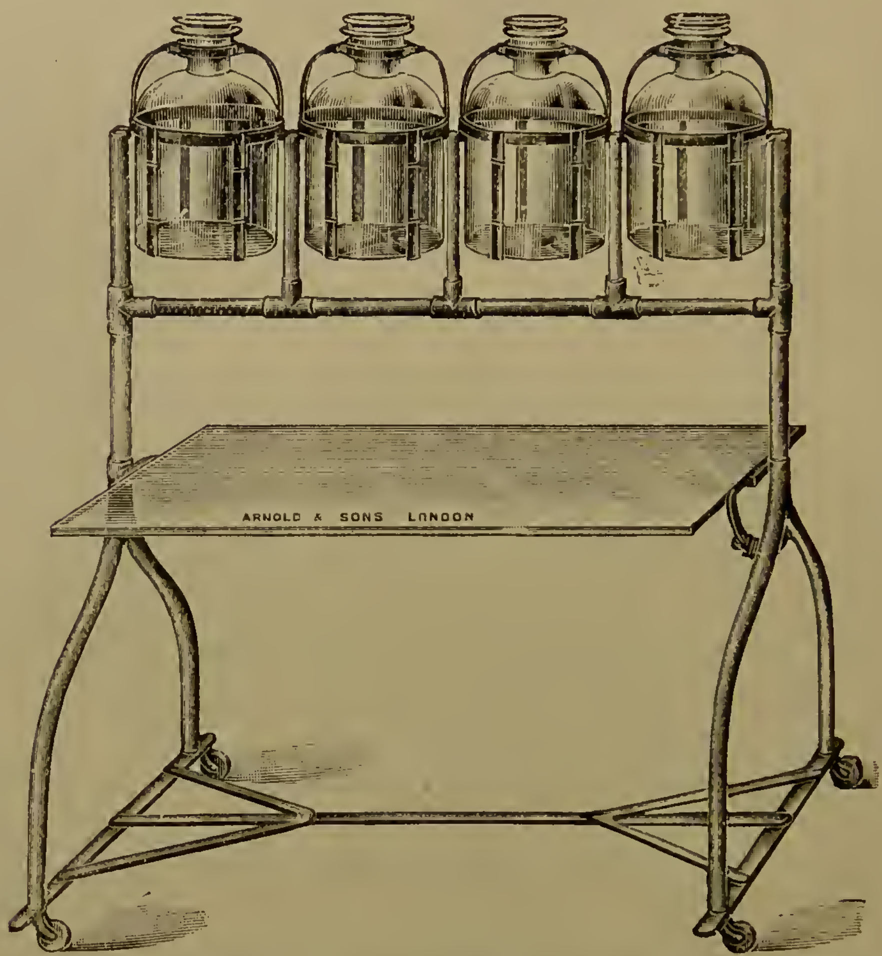


Fig. 17.—Bottle-Stand for Solutions.

Basins, Bowls, Trays, and Plates.—Basins will be required for the sponges, and they may be of glass or enamel. A very convenient table for sponge basins is constructed in the form of a shamrock, three basins fitting into the three divisions (Fig. 19).

The basins and bowls are, after each operation, to be scrubbed with soda and hot water, and are then to be sterilized for thirty minutes in the steam sterilizer; they may then be stored in

nests. Before being used they should be rinsed with 1 in 1,000 perchloride solution.

Glass Bowls.—These are useful for holding sutures and ligatures, while a larger one containing water or iodic hydrarg. solution (1 in 1,000) may be conveniently placed at the end of the kidney-shaped table, so that the operator may turn during the course of the operation and rinse his hands, or it may be placed on a separate stand.

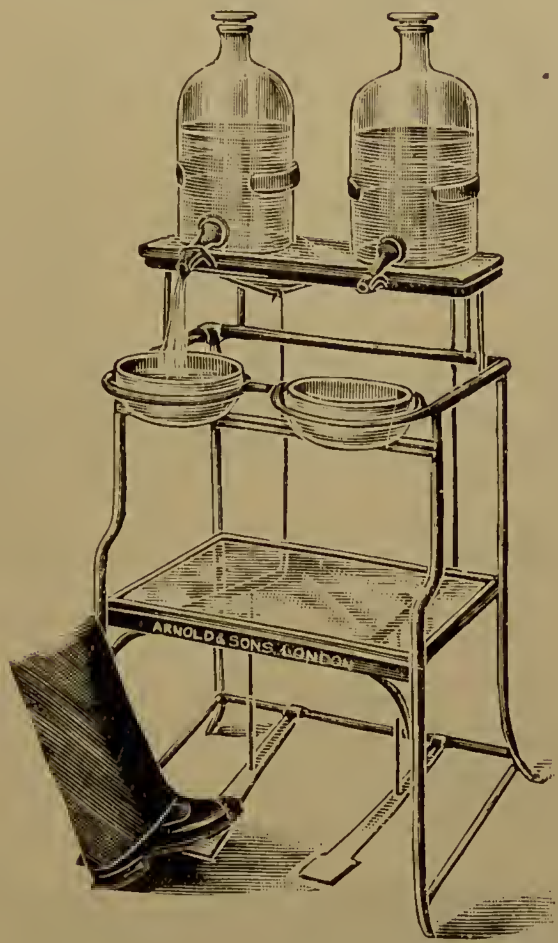


Fig. 18.—Washstand with Foot-Levers to obviate the Hands touching the Taps.

Trays.—A large metal, glass, or enamel kidney-tray is useful during a section. It may be used for holding the fluid tapped from a cyst; it is useful for catching the water which overflows whilst irrigating the abdominal cavity; or it may be used for receiving the specimen after it has been removed from the patient.

Flat trays, made of glass or enamel, are used for holding the operator's instruments. Some surgeons place all their instru-

ments in one tray. Such an arrangement is often confusing when the surgeon has to pick up his own instruments. It will usually be found more convenient to place the instruments in

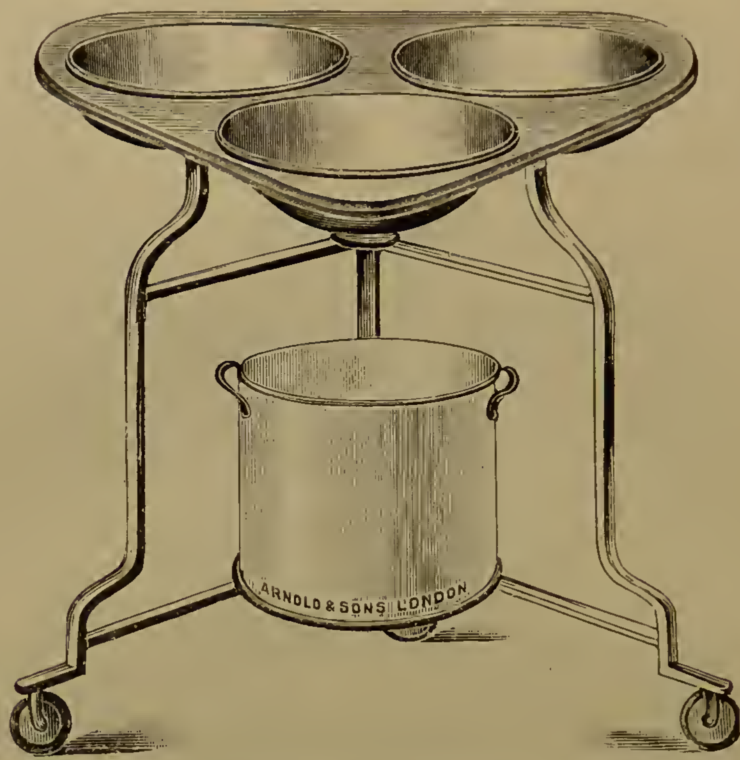


Fig. 19.—Enamelled Iron Washstand for Sponges.

three or four small oblong trays (Fig. 20), putting the forceps into one, and pedicle needle and knife into another; while the remaining instruments, such as retractors and scissors, are placed in the other dishes.

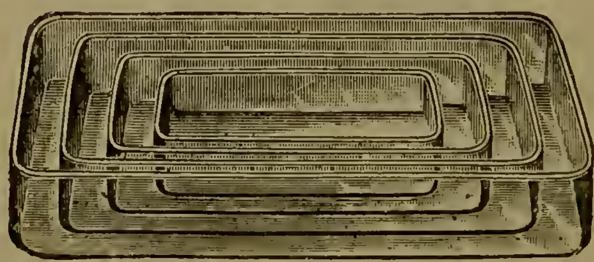


Fig. 20.—Glass Instrument Trays.

Flat trays will also be found convenient for holding the dressing after it is taken out of the sterilizing boxes previous to being handed to the surgeon.

Enamel plates are used for holding needles.

At every operation it is well to have in addition to the basins we have enumerated a nest of half a dozen enamelled basins of different sizes; they are useful for ligatures and sutures, and, if they are not at hand, their absence may cause inconvenience.

Fig. 21.—Irrigator.

Irrigators.—Irrigators are frequently constructed so that they may be hauled up by a pulley and hang suspended over the operating-table (Fig. 21). From such a reservoir a stout rubber tube depends, to the end of which is affixed a metal or a glass cannula. This is a convenient arrangement, especially when we require a strong current for washing out the clots in operating on cases of ruptured ectopic pregnancy, when the rupture has taken place into the peritoneal cavity and the clots are distributed even up to the diaphragm. In such cases Mr. Tait was accustomed, after filling the peritoneal cavity with fluid, to suddenly lower his irrigator and allow the fluid to be sucked out by siphon action, and by this means he displaced many clots that would not have been washed out by the ordinary method of irrigation.

Many operators, including ourselves, prefer to use a glass jug for an irrigator, the water being poured into the abdomen, and by making a funnel of the palmar surface of the hand, the stream can thus be directed into the pelvis or on to any other spot we may wish. A glass funnel with a rubber tube and metal or glass cannula may also be used for irrigation, the water being poured into the funnel from the jug.

The fluid to be used in irrigation is saline solution, and if a flask of this is kept on the sand-bath at boiling-point we shall only have to dilute this with an equal quantity of cold saline solution to get the irrigation fluid at the required temperature, viz., 112° F.; the usual method of mixing the fluid in a hurry just when it is required is not to

be commended, for the temperature is often guessed at by inserting the hand, and often the fluid is too hot and just as often too cold. If a jug is used it should have a thermometer fixed in its side.

Infusion Apparatus.—As we may require to infuse saline solution during the operation, we must always have in readiness the apparatus. This consists of a graduated reservoir, from the base of which hangs a piece of rubber-tubing about six feet in length, to which is attached a large needle. The reservoir should be fitted with a thermometer; it is graduated, and holds four pints. When required for use the warm (100° F.) saline solution * is emptied into the reservoir, which is then suspended by a hook to a cross-bar which runs from one side of the theatre to the other. If there be no bar or stand on which to hang the reservoir it must be held by an assistant, who stands on a chair or stool; but this is a wearisome task, as it often takes twenty minutes for the fluid to run into the tissues. Care must be taken to add some boiling water to keep up the temperature of the fluid in the reservoir.

There are lavabos specially constructed with two reservoirs and two pipes, so that the transfusion may be made under both breasts at the same time. This apparatus is placed out of the way until required, when it can be wheeled up by the side of the anæsthetist, who can steady the cannula after it is inserted in the tissues while the operation is still in progress.

* Vials containing 1 ounce of sterile water, in which is dissolved calcium, potassium, and sodium chloride, can be purchased. The contents of one of these vials, added to a quart of sterile water, makes a normal saline solution.

CHAPTER II

DISINFECTION

A SURGEON with moderate skill, who is scrupulous about his instruments, his hands, and his ligatures, will in the end be more successful than the brilliant operator who is careless in the preparation of his hands and instruments. It is not so long since that it was deemed quite sufficient if we washed our instruments in soap and water, and placed them in a 5 per cent. solution of carbolic acid at the time of the operation.* But it has become evident that while such a simple procedure will suffice provided the previous operation had been a clean one, yet it was quite inadequate if the instruments had been contaminated with pus. In seeking for a reliable means to sterilize instruments, it was soon discovered that disinfection by heat was in every way superior to chemical disinfection; and it only required the experiments of Koch, Gaffky, and Loeffler (who showed that they could kill anthrax spores with steam in five minutes, whereas the same spores were not killed after immersion for thirty-seven days in a 5 per cent. carbolic solution) to forcibly demonstrate this superiority, and to pave the way to its general adoption.

The principle that underlies abdominal surgery now is to make an aseptic wound in aseptic tissues, and to keep the tissues aseptic; and as instruments, ligatures, and the surgeon's hands are the chief methods of conveying infection into the wound, it is absolutely necessary for every man who hopes to become a successful surgeon to thoroughly master the details of the various methods of disinfecting, though he may elect to employ only the simplest methods himself. To know such methods in a general way does not suffice, for by neglecting a step here and there, we only court defeat.

* Watson Cheyne, 'The Treatment of Wounds, Ulcers, and Abscesses,' 1897, p. 56.

At the outset let it be borne in mind that an **antiseptic** is that which prevents, or retards, the growth of the germ, while a **disinfectant** is that which kills it outright; and, further, that when we have an absence of all septic germs, we have a condition of perfect **asepsis.**

The Sterilizing Room.—Although it may be convenient to have a small sterilizer in the operating-theatre* in order to disinfect the instruments before or during an operation, still, it will be found more advantageous, on the whole, to have all the sterilizing done in a small room adjoining the theatre, which is set apart for that purpose alone.

That the air may not be unnecessarily contaminated, it is desirable that the room should not open directly into the operating chamber.

This room should contain a large steam sterilizer for preparing dressings, ligatures, towels, and dishes, and a smaller apparatus for disinfecting instruments. The water should also be prepared in this room previous to being conducted into the theatre.

Beside these apparatus every well-equipped hospital and home should have an incubator for culture tubes, in order to test from time to time the aseptic condition of the ligatures, dressings, and skin of the hands.

Disinfection by Heat.—Heat may be applied for the purpose of sterilization in the form of **hot air, steam,** or **boiling fluids**; each of these have their advantages and disadvantages.

Hot Air has proved a very effectual means of killing germs, but it has several drawbacks. It is found that while some bacteria without spores can be killed by hot water in ten minutes, the same spores have to be submitted to hot air, at a temperature of 140° C., for over three hours before they are destroyed. Again, it is found that some germs without spores are not easily killed by hot air; thus the *Staphylococcus aureus* is killed only after exposure to dry heat at 80° C. for over an hour, whereas moist heat kills the same germ in two minutes.

For the surgeon the chief objection to the employment of dry heat is that to obtain good results he must provide himself with a special apparatus, which is very expensive, owing to its perfect method of construction; and also that even with a good apparatus it is often difficult to raise it to the temperature required,

* Electric heaters are useful for the sterilizing of instruments in an operating-theatre; gas is not suitable.

and most difficult to keep it at the desired point, for it is found that there is sometimes a difference of more than 100° between the temperature at the bottom and at the top of the apparatus. Lastly, the surgeon soon finds that his knives and steel instruments rapidly degenerate through being submitted to these high temperatures.

Should the surgeon determine to use dry heat, the apparatus used by Doyen of Paris is one to be recommended, or Poupinet's stove, figured by Macnaughton-Jones (Fig. 22), which is a small model of that used by Doyen. The sterilization in this stove lasts

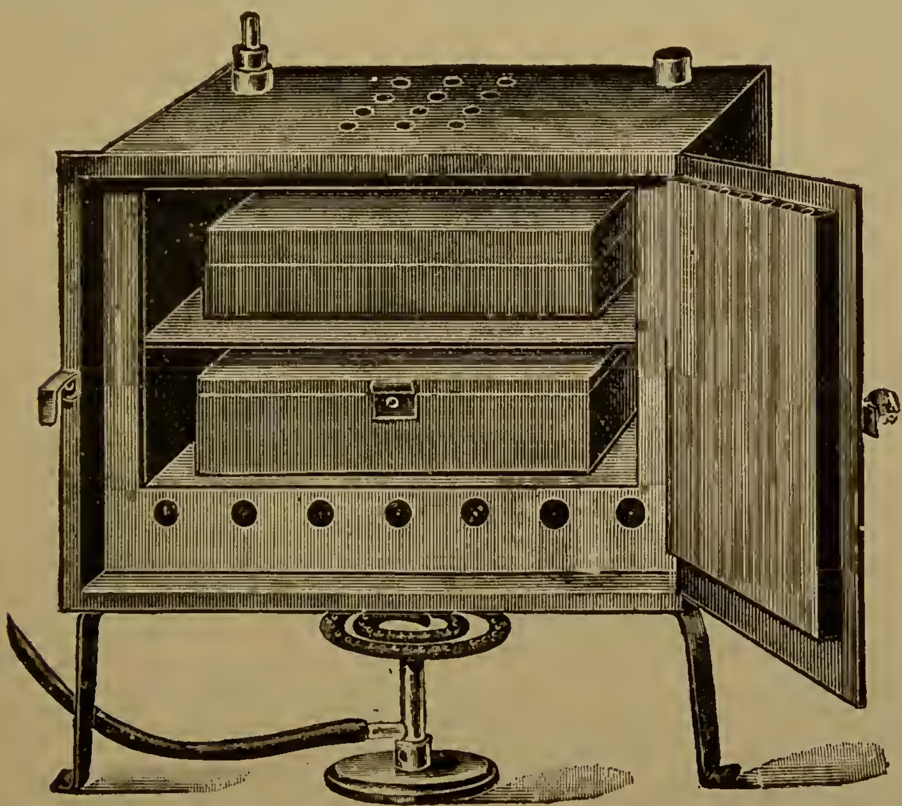


Fig. 22.—Poupinel's Dry Stove.

for an hour, the instruments being placed in copper or nickel air-tight boxes, and the temperature is raised from 150° to 160° C.

Boiling Water.—Disinfecting instruments by means of boiling water has so many advantages over all other methods that it has now become a universal practice. For the reasons of this superiority we have not far to seek.

An abundance of boiling water is always at hand, and in a simple fish-kettle or in a saucepan we have a sterilizer that the most impecunious of surgeons can obtain, and one which will answer all his purposes.

Not only is disinfection by boiling water easy and inexpensive, but it possesses this great advantage over dry heat and steam, that the most resistant spore-bearing germs can be killed in fifteen minutes by it, and that most of the pathogenic bacteria can be killed in a much shorter space of time than this.

Its disadvantages are that steel instruments when sterilized by this method quickly rust, or, if they do not rust, black spots appear on their surface, which imparts to them an unsightly and uncleanly appearance. These difficulties can, however, be almost overcome by placing the instruments in the water after it has come to the boil and by adding to the water 1 per cent. of washing-soda ; we then have a fluid which not only prevents the formation of rust, but which, on account of its penetrating properties, has an actual germicidal power far above ordinary boiling water.

Mr. Lawson Tait, as all the world knows, was an advocate for asepsis as opposed to antisepsis, and he was one of the first to recognise the remarkable properties of the soda solution ; others claimed the discovery, and Schimmelbusch* also made it generally known and popular. The latter author in speaking of the matter says : 'It may fairly be said that boiling soda solution represents the most powerful germicidal agent that we know and can make practical use of . . . An immersion of the instruments for several seconds would therefore be quite sufficient in order to kill the pyogenic germs in them, and boiling for five minutes in soda solution would satisfy all claims in practice.'

The Disinfection of Instruments.—From the remarks that we have just made it is apparent that all instruments should be sterilized in boiling soda solution when possible; therefore it follows that all instruments should be so constructed and so constituted that they will stand the process. Hence the abolition of bone and wooden handles and the substitution of metal ones in their place. Steel, nickel, and silver instruments can be boiled in soda solution without detriment, but aluminium cannot be so treated, as it is rapidly acted on by the soda.

Every hospital has a sterilizer for instruments. These apparatus are of every possible shape and size, and vary from

* 'The Aseptic Treatment of Wounds.' English edition by Rake. London, 1894.

a simple fish-kettle (Fig. 23) to expensive nickel and copper vessels.

These are made about 18 inches in length, 8 inches in width, and 6 inches deep, and may be set on four legs. It is necessary that they should be fitted with an extremely close-fitting lid. The reason for the latter precaution depends on the fact that a 1 per cent. boiling soda solution has a temperature of 104° C. when the lid of the sterilizer closes the vessel perfectly; when, however, the lid does not fit tightly, the temperature may fall several degrees below 100° C.

To hold the instruments two wire-net trays are made so as to slip easily into the sterilizer.*

A Bunsen burner, or gas-ring, when placed beneath the

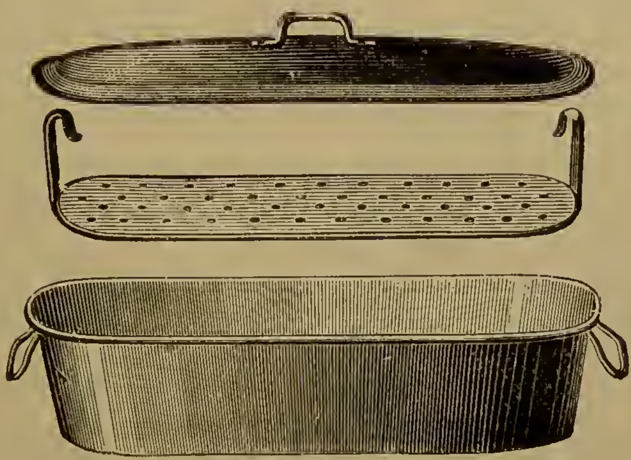


Fig. 23.—Sterilizer for Instruments.

apparatus should be large enough to bring the water to the boil in from five to seven minutes.

In sterilizing instruments for immediate use they are placed in wire-work baskets, and when the water boils in the sterilizer, the trays are placed in the soda solution (1 per cent.) for five minutes; the basket trays are then lifted out of the sterilizer, the soda is washed off with boiling water, otherwise the instruments will feel slippery, and they are then arranged in the dishes prepared for the operation. They may be covered by simple sterilized warm water, or by carbolic lotion (1 in 40 or 1 in 60). Those who

* It has been said that if the instruments are allowed to rest on the bottom of the sterilizer they will suffer from the high temperature. As a matter of fact, the temperature is very little higher for instruments lying in the bottom of the vessel than in the trays an inch above the bottom; we have repeatedly ascertained this with a thermometer.

use warm water hold that it is unnecessary to place instruments in weak chemical antiseptics, for if the instruments are clean they do not need these antiseptic fluids, and if they are not clean they have not been properly prepared, and therefore should not be used by the surgeon. Those, on the other hand, who place their instruments in the weak chemical antiseptic maintain that 'for keeping disinfected things aseptic chemicals are quite efficient when skilfully applied. Dilute chemicals may be confidently relied upon to prevent aseptic instruments, sponges, or dressings becoming infected from the atmosphere, and, I believe, from the skin. They are sufficient to prevent infection by water and a few such sources; our course, therefore, is quite clear: heat is used to disinfect, and chemicals to maintain asepsis.'*

Should an instrument become contaminated during the course of an operation, it may be washed and placed in the sterilizer for five minutes, and it can then be safely used again; this rapidity shows the practical superiority of disinfection by means of boiling water over disinfection by means of steam or dry air.

After an operation the instruments are washed in cold water until they are quite free from blood. They are then scrubbed with soft soap and hot water, and, if tarnished, may be treated with Sapolio or Monkey Soap. They are then placed in the sterilizer with the soda solution, and boiled for ten minutes, after which they are lifted out and placed in boiling water *without* soda by a nurse whose hands have not recently come in contact with septic matter, and who has thoroughly sterilized her hands, or who wears rubber gloves. She proceeds to dry them on a towel which has been also sterilized; to dry instruments on a towel that has not been sterilized is *theoretically* wrong.

When dry, the instruments are placed on glass shelves in a glass case, or they may be placed in linen cases and stowed away in drawers, or in tin cases which are small enough to be boiled every now and then.

In order to facilitate the cleansing of the various instruments, such as scissors and forceps, these should always be fitted with French locks, so that the two pieces may be taken apart; any instrument that cannot be taken to pieces in such a way that all parts of it can be inspected is to be looked upon with suspicion, and should be discarded if a simpler instrument can be had to take its place.

* Lockwood, 'Aseptic Surgery,' p. 161.

After drying instruments that have been boiled in soda solution, it will often be found that a white film appears on them; this is due to the fact that the soda has not been wiped off the instrument. In order to aid its removal it is a good plan to place the instruments in plain boiling water for a short time after removing them from the sterilizer.

It will be found easy to dry any instruments that are removed from water when the latter is boiling; instruments so dried are not so liable to rust.

Whether our instruments should be nickel-plated or not is a matter of taste; the nickel looks well, and aids us in cleansing the instruments, but if in constant use it soon peels off. If our instruments are made of plain steel great care must be taken to see that they are properly dried before they are put away, or they will rust. If after an operation in a private house they are hurriedly dried, they will often be rusty before reaching home.

Some of our instruments require more care in sterilizing than others.

Septic scalpels should be sterilized in boiling soda solution, then sharpened; after this they should be wrapped in cotton-wool, laid carefully by themselves in the basket of the sterilizer, and boiled for not more than ten seconds; this does not spoil the edge, although it may dull it slightly. Prolonged boiling is not necessary, and certainly blunts the knife and spoils the temper of the steel. Some operators,* in order to keep their knives very sharp, do not boil them, but place them for a few seconds in pure carbolic acid, or leave them in alcohol (80 per cent.) for fifteen minutes, or cover them with sp. saponis kalinus. Fowler† says, however, that if they are boiled in hot water to which a little green soap has been added, the edges are not impaired.

In sterilizing needles a small perforated metal box should be at hand. Needles that are boiled frequently soon become so blunt that they cannot be pushed through the skin without great difficulty.

Knives are best stored in metal boxes, and needles may be kept in a strip of linen, in a glass tube, in pure lysol, or in a concentrated solution of washing-soda. We always keep them dry in metal boxes.

Sterilization by Steam.—Steam has many advantages over

* Cheyne and Burghard, 'Manual of Surgical Treatment,' vol. i., p. 163.

† 'Appendicitis,' p. 149.

dry heat, and chief among these are: that the time required is of shorter duration, the apparatus is cheaper and more easily managed, and the temper of the instruments is not so much affected. But notwithstanding these advantages, it takes twenty to thirty minutes in steam, at a temperature of 110° C., before we can be sure that our instruments are sterile, and by that time steel instruments will have become rusty. While, therefore, steam is not extensively used for the preparation of instruments, it is, nevertheless, invaluable for other objects where time is of no consequence, and so it has become the universal means of sterilizing our dressings and some of our ligatures.

It is not unusual to see it stated in works on surgery that a fish-kettle or a potato-steamer is the only apparatus requisite for sterilizing dressings perfectly.* This apparent simplification of steam sterilization has, we have no doubt, led to many erroneous results, for the surgeon is deceived into thinking that since a small apparatus, such as a potato-steamer, is efficient for a few dressings, a larger apparatus constructed on the same plan will be equally efficient. Now while a fish-kettle, when used for boiling instruments, answers every requirement and approaches perfection, when used as a steam sterilizer it does not, and it would be well for every surgeon to clearly understand this. We shall, therefore, at some length mention various points in connection with efficient steam sterilization.

1. The sterilizing-chamber should have rounded sides for preference. Frosch and Clarenbach have, however, shown that the steam reaches the angles and corners of a square chamber if every point of the chamber can be reached by a horizontal path.

2. The smaller the sterilizing chamber the more easy will it be to fill it with steam completely.

3. All steam sterilizers should be surrounded by a steam jacket, in which the live steam circulates freely before it enters the sterilizing chamber; this has the effect of (1) increasing the activity in the circulation of the steam in the sterilizing chamber; (2) of increasing the temperature of the steam; (3) of helping to prevent condensation; (4) of causing re-evaporation after condensation.

4. In order to facilitate the chamber being filled with steam,

* 'For ordinary purposes the simple kind of steam sterilizer is all that is required. . . . A steam sterilizer is by no means essential if an ordinary saucepan is at hand' (Lockwood).

the sterilizing chamber should be so arranged that the air can be withdrawn, and a vacuum thus created, before the steam is admitted, thus helping to prevent condensation and to increase the pressure of the steam.

5. The steam should always enter the sterilizing chamber from above, not from below, because steam, being lighter than air, if allowed to enter from below will rush to stream out above, and thus the air is imperfectly displaced from the sterilizing chamber, which consequently is not completely filled with steam.

6. The sterilizing chamber and the materials to be sterilized should be warmed by the live steam (circulating in the jacket) before the steam is actually admitted into the chamber. If this precaution is not taken, the steam, on coming in contact with the cool sides of the chamber and the dressings, will give off some of its latent heat, and condensation will be the result, and the dressings will be made very moist.

7. The penetrating power and the germicidal effect of steam varies directly with the pressures it is subjected to; consequently steam sterilization is more rapid and more efficient the higher the tension of the steam, therefore the most efficient sterilizer will be one in which the pressure may be carried up to 15 or 30 pounds to the square inch.

The Sterilization of Dressings.—If we use steam under pressure, we can effectually sterilize our dressings at one exposure of half an hour; but if the steam is not under pressure, then the dressings must be exposed to its influence on three successive days, so that we shall be sure that the spore-bearing germs have been destroyed. The method is called **Fractional Sterilization.**

For sterilizing our dressings on a very small scale, all that we require is a metal or an enamel vessel with a well-fitting lid, and a perforated tray raised some inches above the water. The steam is generated, comes in contact with and penetrates the material, and three-quarters of an hour **after** the thermometer (which is inserted in an aperture in the lid, and held by means of a rubber cork) has registered 100° C. the process is complete. Probably this would suffice for most materials, but we make the process certain by repeating the sterilizing on two subsequent days for half an hour.

Of the many steam sterilizers in use, none are superior for disinfecting dressings on a very small scale to Arnold's or

Schimmelbusch's (Fig. 24), which are so arranged that the lower portion can be used for disinfecting instruments with boiling water, while the upper portion is arranged for sterilizing dressings.

If, however, we wish to sterilize large quantities of dressings, towels, or operating suits, an apparatus constructed on the simple lines that we have described does not prove sufficient or effectual; the disinfecting chamber, as we have shown above, is not completely filled with saturated steam, as the air contained in it and in the dressings is difficult to dispel entirely. For these reasons various sterilizers have been invented which are more serviceable for hospitals and homes.

The large sterilizer that we have in use at the Lewisham Hospital is similar to the one in use in Von Bergmann's Clinic

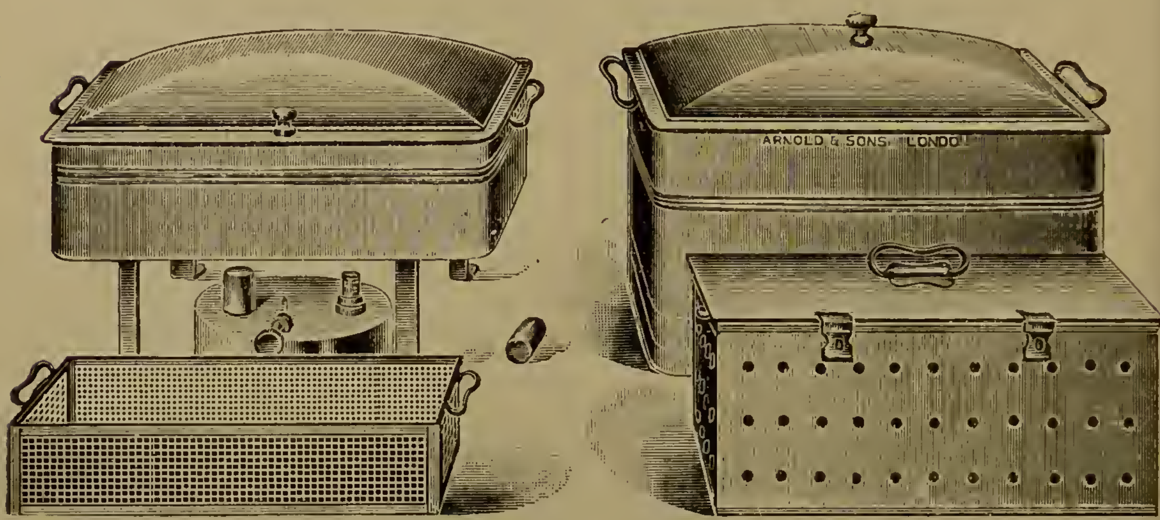


Fig. 24.—Sterilizer for Instruments and Dressings.

at Berlin. It was designed by Lautenschläger, and bears his name (Fig. 25).

It consists of two copper cylinders A and B, one placed within the other, and these are in turn surrounded by an outer jacket C. Between A and B is a space into which water is admitted by the glass gauge E, which is also connected to a cross-pipe P and tap, which admits of the water being drawn off from between A and B. Beneath the cylinder B is placed a powerful Bunsen burner F. A heavy metal lid L fits securely on the top of the apparatus, and its centre is perforated so as to admit a thermometer T. Sufficient water is admitted into the space between A and B to rise about half-way in the gauge-pipe E. On lighting the Bunsen burner steam is soon generated in the space between A

and B, and, rising up, is prevented from escaping by the securely fastened lid L, so that it is forced to penetrate into the inner chamber A through the holes H placed about an inch below the top of the cylinder B. The steam is then forced downwards, and after finding its way gradually through the perforations in the

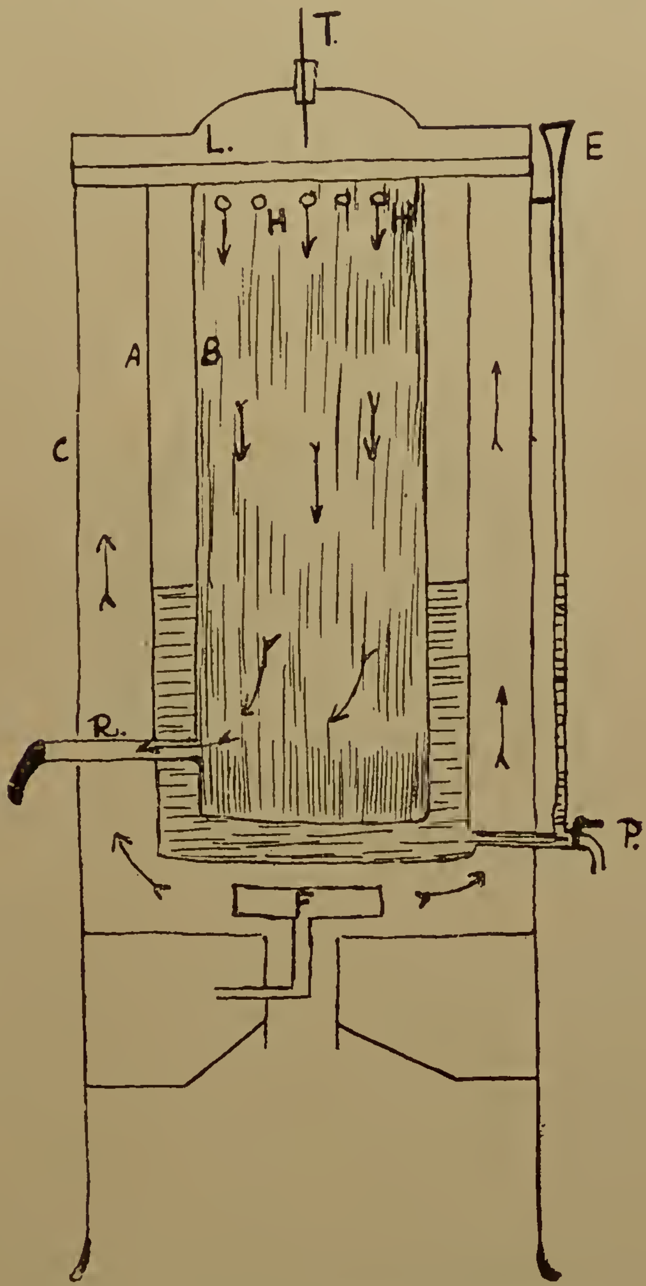


Fig. 25.—Diagram of Lautenschläger's Sterilizer.

metal boxes containing the dressings, it is allowed to escape through the pipe R, which leads into a can of cold water.

The time required to sterilize dressings in this apparatus is about an hour, for it takes fully fifteen minutes before the steam is freely generated and before the thermometer registers 100° C.,

and *from that time* we should allow three-quarters of an hour to elapse before stopping the process; on the two subsequent days half an hour will be sufficient.

The diameter of the inner chamber of the sterilizer is about 19 inches, and its height is 27 inches, so that it is quite large enough to contain two perforated metal boxes 18 inches by 9 inches, which are employed to hold the dressings during the process. These boxes are so constructed that the sides are perforated by a number of round holes (Fig. 26); a perforated band of metal surrounds the box, and is so arranged that the holes in the band may be placed so as to correspond with holes in the box, while, on the other hand, by moving the band the non-perforated portions will close the perforators in the box.

When the box has been filled with dressings, and the outside

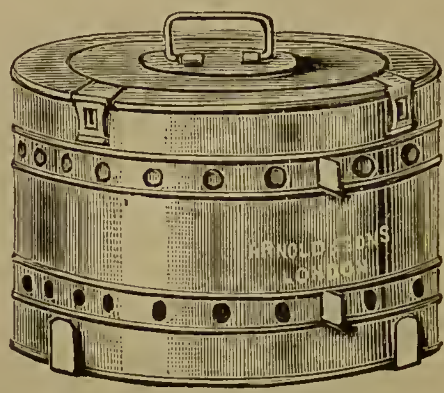
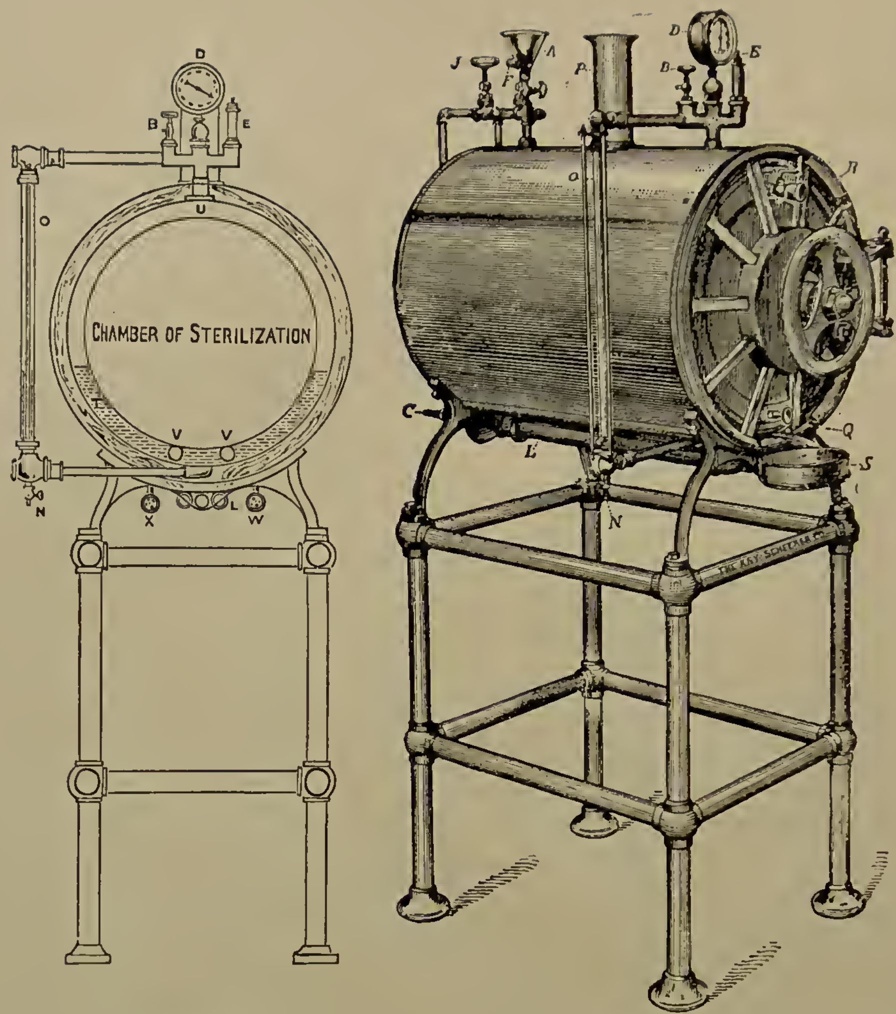


Fig. 26.—Kettle for Sterilizing Dressings.

movable portion is adjusted so that its perforations correspond in position with the perforations of the box, the latter is placed in the sterilizer, and the steam is thus enabled to penetrate through the perforations and then through the dressings.

When the disinfection is complete, and we remove the box from the sterilizer, the outside band is moved, and its non-perforated portions then slide over and close the holes of the inner cylinder; the box is thus made air-tight and impervious to dust, and in this manner it may be transported to a distance, should we wish to operate at a private house. Some surgeons have leather cases made so that the metal box may be slipped into it, and this makes transportation more certain.

With regard to the actual sterilization, we proceed as follows: When the boxes are filled with dressings, towels, or any other articles that we wish to disinfect, they are placed in the sterilizer,



SECTIONAL VIEW. CUT OF FRONT END.

PLATE VIII.—KNY-SCHEERER DRESSING-STERILIZER.

A, funnel and valve where water is taken into the jacket; *B*, valve for the discharge of air displaced by the water; *C*, gas-attachment; *D*, pressure-indicator; *E*, the safety-valve; *F*, the valve which controls the steam for vacuum apparatus; *H*, ejector, or vacuum apparatus; *J*, the valve admitting steam from jacket to chamber; *K*, valve connecting air-ejector to chamber; *L*, horizontal gas-burner; *N*, the valve to draw off water from the jacket for cleansing purposes; *O*, glass water-gauge; *P*, ventilating-pipe for gas-combustion; *Q*, test-valve for steam in chamber; *R*, an air-filtering valve for destroying vacuum; *S*, catch-basin for any possible drip from door; *T*, water-space in jacket; *U*, steam-space in jacket; *V*, coils for heating water, using steam from the general plant of an institution; *W*, connection for steam inlet; *X*, connection for steam return.

To face p. 35.

the lid is firmly secured by several catches attached to the lid, the thermometer is inserted through the aperture in the lid, and the gas-burner is lighted. When the thermometer registers 100 C., note the time, and the dressings are subjected to the action of the steam *for three-quarters of an hour from that time.* This should be done, as stated above, on three successive days.

If, after turning off the gas, we remove the boxes immediately from the sterilizer, the dressings will be found somewhat damp. But the dampness is not very pronounced, because the dressings are heated for fully fifteen minutes before the disinfection begins; for the steam is not generated, and does not begin to circulate for that length of time after the process is started, and during this interval the temperature of the dressings is raised, and, as stated in our preliminary propositions, steam does not so readily condense on warm as it does on cold dressings.

In order that the dressings may dry, it is necessary to turn off the gas and open the lid of the sterilizer, or we may even remove the boxes and leave the lid and the sides open.

Excellent as Lautenschläger's sterilizer is, it has been much improved upon of late, for inasmuch as the tension of the steam in it is only $\frac{1}{30}$ of an atmosphere, the steam lacks penetrating power, and it is not so germicidal as steam under a pressure of from fifteen to twenty atmospheres.

The improved sterilizers have these advantages, and one of the most popular is known as the 'Kny-Sprague Sterilizer.'* McBurney† thus describes it: 'It consists of a cylindrical chamber surrounded by a steam jacket, attached to which is an arrangement for creating a vacuum when required. The water is heated from beneath by gas, or by steam collected through pipes from some neighbouring boiler. The steam jacket half filled with water generates the requisite amount of steam, under pressure of from 10 to 20 pounds at a temperature of from 230° F. to 260° F. (Plate VIII.); then the air in the sterilizing chamber is exhausted by a vacuum apparatus and the steam turned in. The steam is allowed to circulate freely for from fifteen to thirty minutes, according to the density of the objects exposed, and is then turned off. The residual steam is now removed by creating a vacuum, and the materials are then dried by the heat generated

* Manufactured by the Kny-Scheerer Company, of New York, U.S.A.

† 'International Textbook of Surgery,' vol. i., p. 268.

in the jacket surrounding the chamber. This will require from ten to twenty minutes.'

It is well to remember that 'the best penetration can be obtained by relaxing the pressure during sterilization and refilling the chamber with steam several times, thus driving out the air in the materials to be disinfected.'

As the Kny-Sprague Sterilizer is a large and expensive apparatus, others have been introduced which act quite as well and are less expensive, and take up less space. One of the best of these is Chamberland's **autoclave** (Fig. 27). A

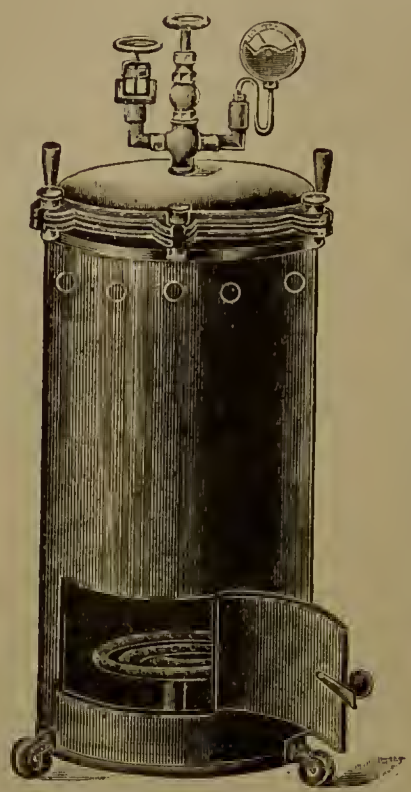


FIG. 27.—Autoclave for Vapour Sterilization of Dressings.

steam gauge here indicates the pressure, and a safety valve prevents accidents.

Whether we use a simple apparatus, or whether we are dealing with a much more elaborate one, we should be most careful that the dressings, rolls of gauze, or towels are not too tightly folded, or the steam will be unable to penetrate and sterilize the centre portion of the various articles. The experiments of Koch, Gaffky, and Loeffler show clearly that steam takes some considerable time to penetrate into towels and rolls

of cloth. In one experiment a roll of coarse thick cloth 25 centimetres by 8 centimetres was exposed to superheated steam which in thirty minutes reached 120° C., but the temperature at the centre of the roll had not in thirty minutes reached 65° C.; but the steam being raised to 126° C. and kept at that for thirty minutes more, the temperature of the cloth rose to 118° C. (Lockwood).

The corollary to the above experiment is that we must either expose our dressing packed in the loosest possible manner so that the steam may easily penetrate, or we must use an apparatus such as we have described above in which the steam is under pressure, so as to increase its penetration and its germicidal powers.

In practice, then, it is well to place the dressings in a series of wire cages, so arranged that, whilst one fits above the other, they are nevertheless separated by a space through which the steam may freely circulate. The trays may be so constructed that they will fit into the metal dressing-boxes described above.

To anyone who is constantly engaged in sterilizing dressings this question of the penetrating power of steam must often suggest itself. The mere fact that the thermometer of the disinfecting chamber registers 100° C. is no proof that the centres of the dressing are at that temperature, and therefore we look round for some ready means of ascertaining this fact.

Mikulicz suggests the following:* A strip of unsized paper is marked with the word 'sterilize,' and is then painted over with a 3 per cent. starch paste. When half dry it is again painted with a potassium iodide solution, made by adding 1 part of iodine and 2 parts of potassium iodide to 100 parts of water. The strip at once becomes of such a dark-blue colour that the writing is completely concealed. In hot steam the dark-blue colour disappears, or at least to an extent sufficient to enable the writing to become distinct. Dry heat will not accomplish this result. Under pressure in an apparatus in which the steam is raised to a temperature of 106° C., the strips which are hanging free are decolourized in ten minutes, those which are placed in the middle of the dressing not for twenty minutes or over. If the temperature is less than 100° C., more than an hour is required for the decolourization. The strip of paper thus prepared and placed in the centre of a dressing proves positively

* *Therapeutic Gazette* (extract from *Archives of Clinical Surgery* vol. lxvii.).

that the dressing has been subjected to hot steam, and not hot air; that the steam has been sufficiently hot for thorough sterilization; and that it has operated for a sufficient length of time. Experimental research has shown that even the most resistant bacteria are destroyed before the decolourization of paper thus prepared.

Terrier suggests a different plan, viz., to place among the objects to be sterilized a glass tube, closed at each extremity, and containing some crystallized substance which by its fusion denotes when the desired temperature has been exceeded or at least reached. Thus, for the compresses tubes with anhydride phtalique, fusing at 129°; for silk tubes with benzoic acid, fusing at 120°; and for the stoves of hot air tubes with salicylic acid, fusing at 156°. These substances are coloured respectively green, violet, and red with aniline. As a powder the mixture is scarcely coloured, but it becomes very accentuated under the process of fusion when the mass is rendered compact. This change in colour is an assurance of the sterilization, provided that the test-tube has been placed in the centre of the compresses (Macnaughton-Jones).

CHAPTER III

STERILIZATION OF WATER—STERILIZATION OF TOWELS—CHEMICAL DISINFECTION

Sterilization of Water.

Tap-water contains many species of bacteria, the majority of which, fortunately, are not pathogenic ; nevertheless, the *Staphylococcus pyogenes aureus*, as well as *Bacillus coli communis*, and other germs, have been so frequently found that it is now the custom to boil all water to be used at an operation.

When the quantity required is limited, no special apparatus is needed for sterilizing the water, for this may effectually be done by simply boiling the water in a clean vessel for half an hour, and then placing it in covered vessels. After allowing it to stand for some time the organic matter and particles from the pipes settle to the bottom of the vessels, and the clear water may be drawn off by a spigot. Some of this is placed in an enamel-ware water-can with a closely-fitting top, and the spout is plugged with cotton-wool—this will cool and be so used when required—while the other portion is placed in a similar can, and previous to the operation this may be placed over a large gas-ring to raise it to the boiling-point.

As a matter of fact, it is not necessary to boil water for more than five minutes to sterilize it and to destroy the pathogenic germs effectually. After that time the bacteria that survive are not pathogenic, but are only saprophytes, which on being introduced into the body and supplied with albuminous fluids may manufacture sapric substances and give rise to the phenomena of sapræmia. By boiling water for half an hour we effectually put an end to these germs.

To sterilize large quantities of water for an operating theatre a special apparatus will be required (Fig. 28). These have now multiplied until their name is legion. The one that we use at the Lewisham Hospital is most convenient and effective (Fig. 29).

The water is brought to the apparatus along the pipe P (Fig. 30). On turning the cocks at A and B the water is admitted into the reservoir R, and this is filled to three-quarters of its capacity.

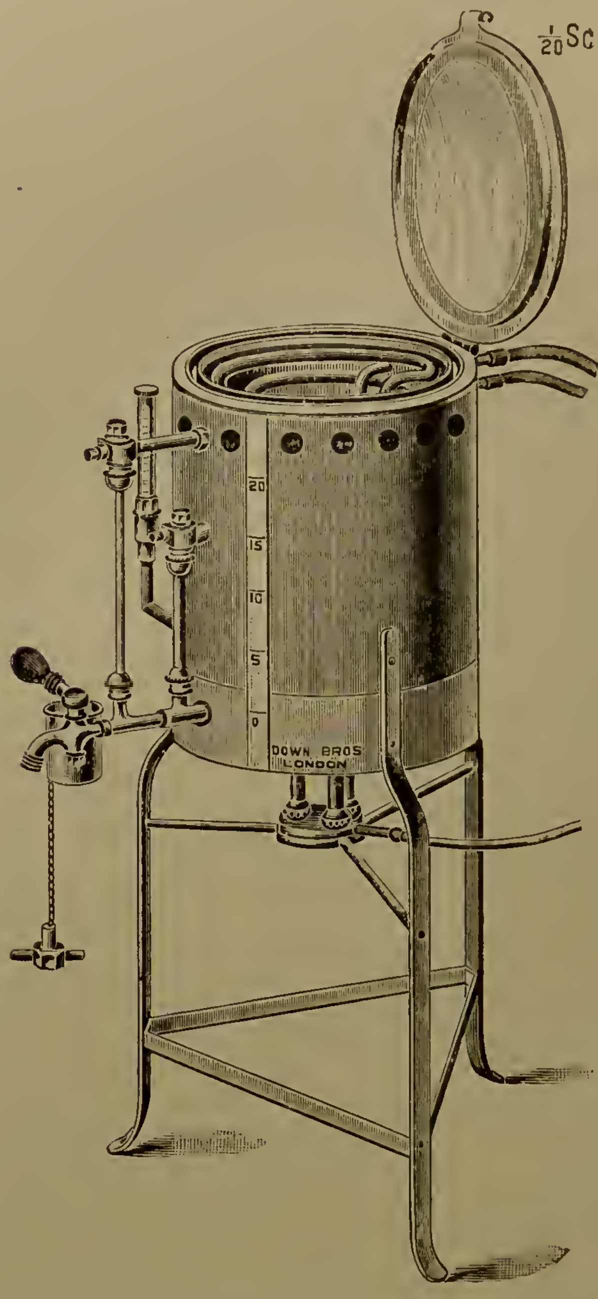


Fig. 28.—Water Sterilization Apparatus.

water is first boiled, and the temperature then reduced to a suitable point for surgical use b circulating a stream of cold water through the reservoir by means of a spiral tube. The temperature is indicated by the thermometer.

In order to sterilize the water now in reservoir R, the cock at A is closed and the cocks at B and C opened. The water runs down the pipe past B, enters the heating apparatus E, and ascends

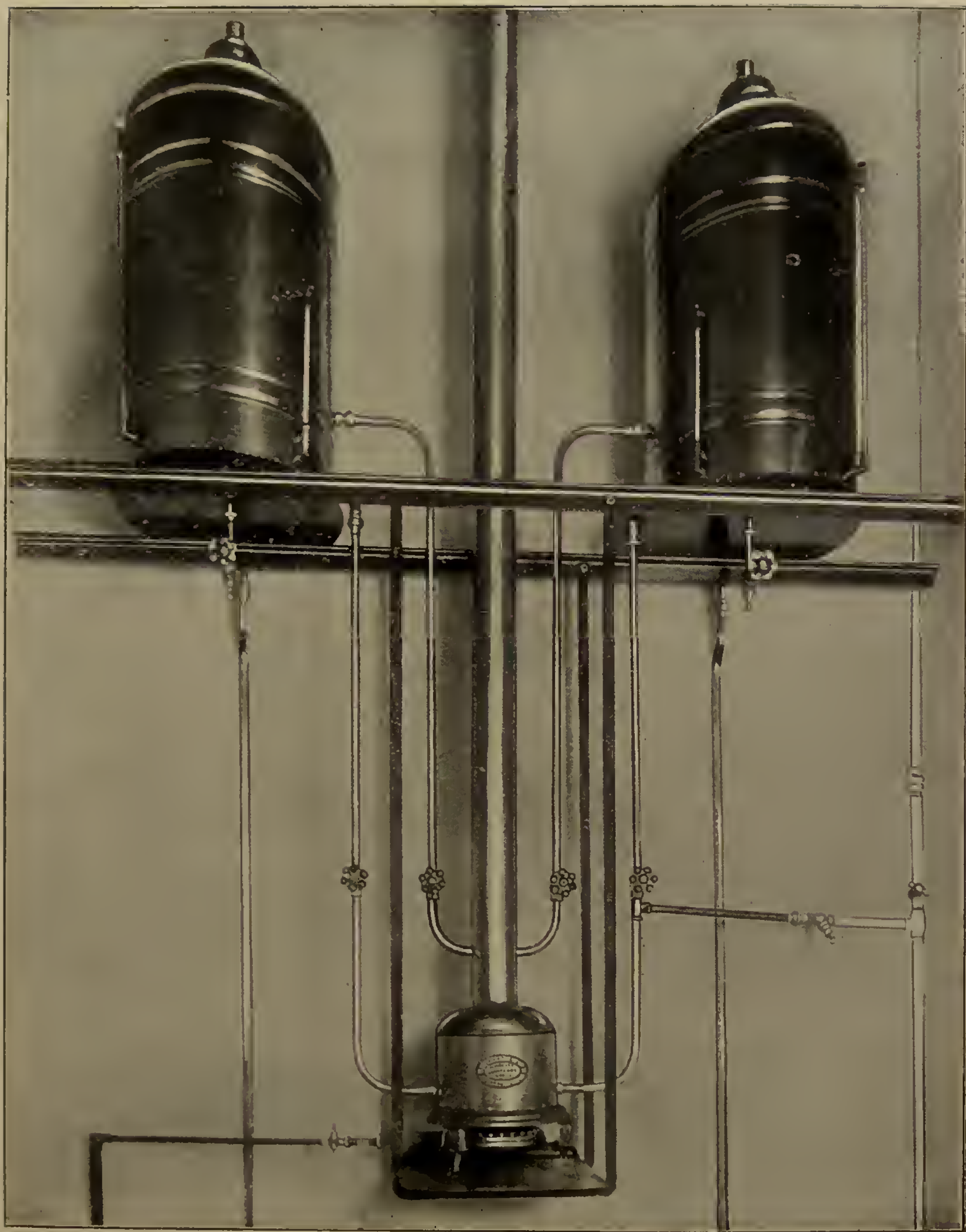


Fig. 29.—Water Sterilizer. (Lewisham Hospital, Sydney.)

To face p. 40.

through the pipe past C. The hot water then circulates through R, and soon the whole is raised to boiling-point, the fact being ascertained by the thermometer fixed to the reservoir. If now we wish to fill the opposite reservoir R^1, the cocks at B and C, C^1

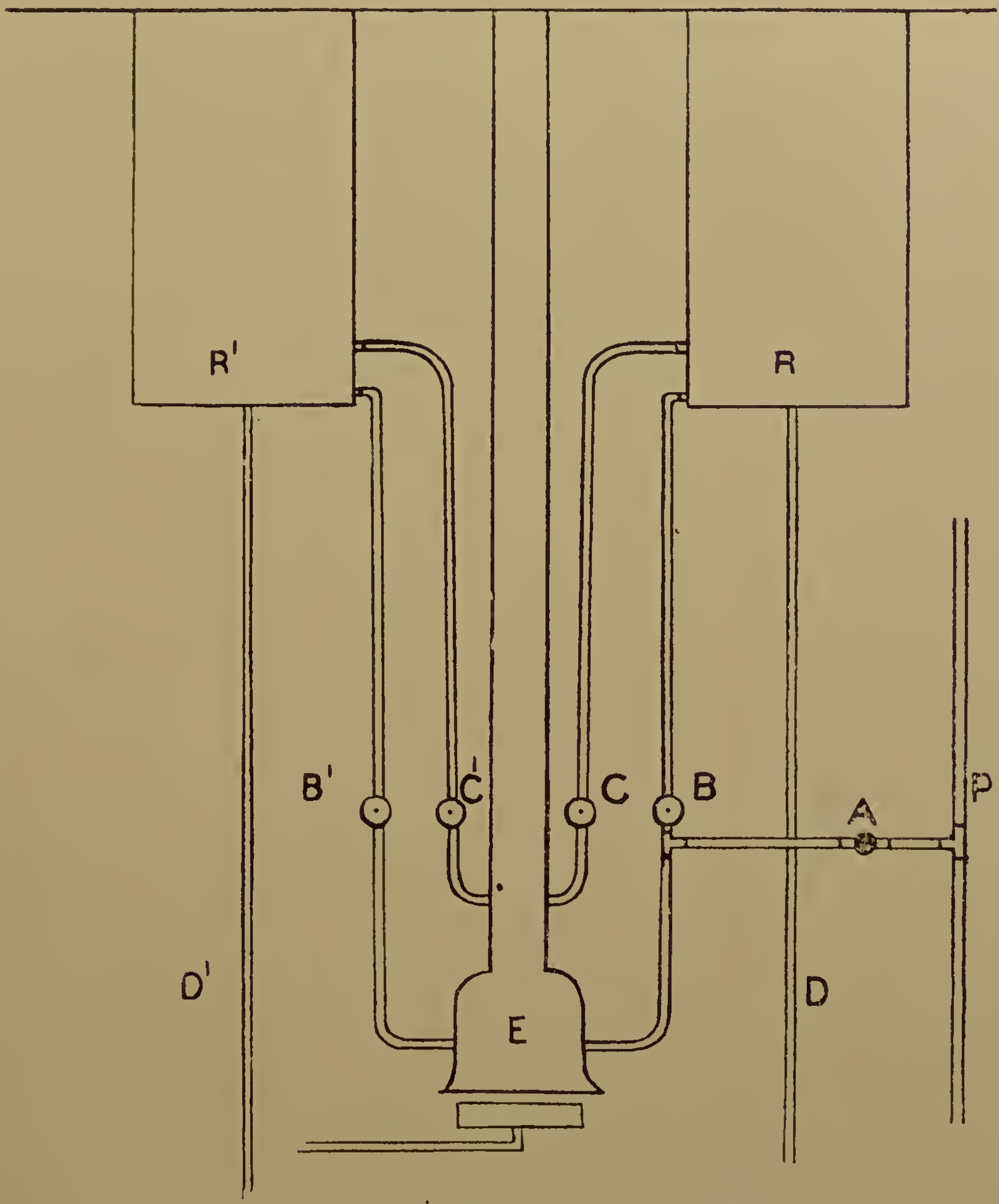


FIG. 30.—Diagram of Water Sterilization Apparatus at the Lewisham Hospital, Sydney.

are shut, and the cocks at A and B^1 are opened. When R^1 is filled the cock at A is closed, and the water in R^1 is boiled in the manner described for the first reservoir R. The water thus prepared in the reservoirs is allowed to cool, but previous to an operation the water in one of the reservoirs (R) is again boiled,

so that we may supply hot water through the pipe D to the theatre, and cold water through D^1.

In supplying the theatre with water in the manner indicated, the weak point lies in the fact that the water must be conducted through pipes, and any spores that have escaped destruction and which linger in the pipes may develop in the pipe and be washed along with the stream, which may be powerless to render them harmless. For this reason, before any water is used the pipes should be flushed out with the boiling water. As a matter of fact, such objections are more theoretical than practical.

Should, however, we wish to obtain absolutely sterile water to be used for flushing the peritoneal cavity, the following plan may be adopted: Glass flasks are sterilized with sublimate, and are filled almost to the top with boiled or distilled water. The mouth of the flask is plugged loosely with cotton-wool, and the water placed for an hour a day for three successive days in the steam sterilizer; when required for use it may be warmed on the sand bath.

Sterilization of Towels.

Towels are used at a section for drying the hands, for surrounding the field of operation, and for wrapping the patient's hands and arms in.

Many surgeons are accustomed to place a damp towel on the clothes covering the patient's thighs and pubic region, and on this towel is frequently placed forceps and whatever instruments may be in use. It is obvious that this towel may be a weak spot in the carrying out of a rigid asepticism, and for this reason some operators have a small frame to fit on the sides of the table and made to stretch across above the thighs, so that they may place their instruments in a dish on this frame.

Towels that have been used at a septic operation should be taken and rinsed in water immediately after the operation; they should then be washed with common yellow soap and boiled with soda for one hour. After being dried, they may be ironed, and should then be placed unfolded in the sterilizer for an hour on two successive days; they may be then stored in metal boxes. The towel that covers the clothes over the pubes and thighs may be soaked in carbolic (1 in 40) for two hours before the operation.

The towels that we wish to use dry may be conveyed into the operating-room in the upper part of a simple sterilizer (such as

Arnold's), or they may be placed in a nickel or a glass box, from which they are taken when required. These towels should be small, and when once used should be thrown into a bucket. They should not be used a second time during any operation.

It is well to remember that in order to disinfect a towel in a simple sterilizer it must be loosely folded. In one of Lockwood's tests he steamed a towel for half an hour and soaked it in carbolic solution (1 in 20) for more than half an hour; but in spite of this it grew staphylococci, cocci in chains of six, and a spore-bearing bacillus. He thinks that it was not properly disinfected by the steam because it had been folded tightly.

It is well to remember that if towels are soaked in sublimate they become very discoloured.

Chemical Disinfection.

As it is impossible to disinfect our hands, the patient's skin, our sponges, and some of our ligatures by means of heat, we are forced to resort to disinfection by means of various chemical substances.

It is seldom that we are called upon to use these substances during the course of a section; their use is in the preparation for the operation, not during the operation itself.

We shall only note some of the best-known substances, and indicate their special use.

Bichloride of Mercury.—This substance is chiefly in use in disinfecting the hands or the patient's skin.* It is never to be used on a wound surface, because it causes a superficial necrosis of the tissues, the effect of which is ultimately to favour the multiplication of any micro-organisms that may be present. The most convenient way of making sublimate solution, for whatever purpose employed, is to use 'soloids,' one of which, when placed in a pint of warm water, makes a 1 in 1,000 solution.

Biniodide of Mercury.—This substance has largely taken the place of sublimate, for it possesses many advantages. It is not so poisonous as sublimate; its germicidal power is twice as great as sublimate. It does not precipitate albumin, and, therefore,

* Sublamin, mercury sulphate combined with ethylenediamine, does not irritate the skin, and has greater penetrative power than sublimate.

may be used to wash the surface of a fresh wound; for no necrosis follows, and as no albuminate of mercury is left in the wound, bad effects are less likely to follow. Its penetrating power is superior to sublimate.

Biniodide is employed for the preparation of sponges and ligatures and for disinfecting the skin. At the time of the operation it may be employed to rinse the hands with or to place the sponges in; while in cases where septic matter has escaped into the abdomen, Lockwood says that he has washed it out with a 1 in 4,000 solution of biniodide without any ill-results. After walling off the field of operation, we have sponged out Douglas' pouch with a solution of biniodide in spirit (1 in 500) in cases of pyosalpinx when some of the pus had escaped. The patients recovered without ill-effects.

After removing a pyosalpinx, it is a good plan to rub the stump with a tabloid of biniodide, and the same procedure may be followed in dealing with the appendix.

Biniodide can be obtained in the 'soloid' form, so that one soloid in a pint of water will make a 1 in 1,000 solution. As, however, these soloids are three times more expensive than the soloids of sublimate, a stock solution of biniodide may be prepared, according to Lockwood, in the following manner: The biniodide powder is shaken up with distilled water, and rather more than an equal weight of iodide of potassium or of iodide of soda is added. It is advantageous to add a little more iodide if hard water is used instead of distilled water.

Carbolic Acid.—Carbolic acid is used to preserve sterile sponges and for placing instruments and ligatures in at the time of the operation, so that the disinfected things may be kept aseptic. Many operators, however, discard all antiseptic lotions for their instruments, and Kelly says that the germicidal effect of carbolic solution for instruments is more than counterbalanced by the injury which it causes to the hands. Lockwood, however, always immerses his instruments in a 2 per cent. solution during the operation.

A stock solution of carbolic may be prepared in the following manner: 1 kilogramme of absolute phenol is dissolved in 1 kilogramme of alcohol (90° C.). A litre of this fluid is placed in a jar containing 19 litres of boiling water; we then have 20 litres of a 5 per cent. solution of carbolic. In order that needles and steel instruments may not rust in this solution,

Doyen advises the addition of 60 grammes of powdered borax.*

Microcidine.—This substance is one that is not much employed, but Tarnier in his great work 'De l'Asepsis et de l'Antisepsis en Obstétrique' praises it, and places it next to sublimate as a disinfectant and antiseptic. We used it for three years in sterilizing instruments, and we consider that it has almost the germicidal power of sublimate combined with all the penetrating and disinfecting power of washing-soda, and for this reason it may be employed to disinfect septic instruments with great advantage.

We prepare it by making a lye of caustic soda to contain 1 part of soda to 2 of water, and add to it β-naphthol in the proportion of 2 of naphthol to 1 of soda. Bring the mixture to the boil, and leave for about fifteen minutes until the naphthol is dissolved. The result is an almost colourless liquid, which on being evaporated forms the solid microcidine, which should be kept in a dark, stoppered bottle.

It is used in a solution of 4 in 1,000, and it is not at all poisonous. Its penetrating powers are due to the soda, and it is especially useful if instruments have grease on them.

Permanganate of Potash and **Oxalic Acid** are drugs which are now to be seen in nearly every operating theatre; they are used in preparing the skin and in disinfecting sponges and brushes.

Peroxide of Hydrogen.—This is an energetic disinfectant. A 20 per cent. solution of a good commercial hydrogen peroxide solution will quickly destroy the pyogenic cocci and other spore-free bacteria.

In the following table (from Park) the figures represent the percentage of the substance required to be added to a fluid containing considerable organic material in order to permanently inhibit any bacterial growth:

Boric acid	1 : 143
Carbolic acid	1 : 333
Mercuric chloride	1 : 14,300
Hydrogen peroxide	1 : 20,000
Mercuric iodide	1 : 40,000

Having long noticed its cleansing power when applied to foul

* Macnaughton-Jones, *loc. cit.*, p. 55.

wounds, we have frequently swabbed out Douglas' pouch with this fluid, using it undiluted.

It causes oozing from bleeding surfaces, and we have often seen a rise of temperature after using it on a suppurating wound surface, since it opens up channels for absorption.

After closing the abdominal wound we generally wash the skin and sutures with peroxide, and frequently soak the plain gauze that covers the wound with it. It should never be used in the presence of iodoform. We believe that we have seen two deaths due to iodoform poisoning, the iodoform having been sprinkled on the raw surface swabbed by peroxide.

Boracic Acid.—Powdered boracic acid, which has been sterilized by being heated to 150° C., is often used to dust on the skin after closing the abdominal wound.

Tait often covered the skin with it an eighth of an inch deep. Others use a mixture of boracic acid and iodoform (7 to 1) which has been placed in an ignition tube and then sterilized in the autoclave; whilst others use dermatol, iodol, aristol, salol, sozoiodol, or sulphammol.

Lysol (2 per cent.) is useful for washing the vagina previous to performing a section in which we expect to open into the vagina.

CHAPTER IV

STERILIZATION OF LIGATURES AND SUTURES

Catgut.

The preparation of catgut for surgical purposes has engaged the attention of one observer after another since Lister first made this material popular.

In spite of its many advantages, catgut has the one great disadvantage, that it is difficult to disinfect, and this is the reason why we have the innumerable methods for preparing it that we find scattered through surgical literature. So distrustful, however, are some surgeons of catgut that they have ceased to employ it, exclaiming with Kocher, 'Fort mit dem catgut!'

It is quite possible to be independent of catgut in section work, and we never saw Mr. Tait use a catgut ligature or suture in any section case that he had to deal with; he was content to use fine silk, for he could be sure of its aseptic condition. Many will be inclined to agree with this practice; and yet, on the other hand, some good operators never use anything else but catgut. Recently it has become the custom to close the abdominal incision in layers, and as the suture material most frequently employed is catgut, it is necessary to consider at considerable length the subject of its preparation, for nothing can be more vexing than to perform a section well, and find, when the patient is over the danger of the first few days, that we are confronted by an abdominal incision whose hidden depths are dotted with suppurating foci. We believe that we lost one case from such a disaster after using No. 4 catgut, bought from a reliable (?) firm, but without preparing it afresh ourselves.

Catgut is made from the submucous tissue of the intestines of lambs, the mucous membrane and the circular muscle fibres being scraped away. After being treated with alkalies and bleached by sulphuric acid, it is cut into lengths, twisted into

cords, and dried. It is apparent, if the intestines from which the catgut is prepared are infected, that unless the gut is thoroughly disinfected, we shall introduce into our wounds a dangerous source of infection, and Zweifel, Kocher, Volkmann, and Owens have all recorded cases of anthrax infection after the use of catgut.

The chief difficulty in disinfecting catgut arises from the fact that we cannot boil it in water without destroying it, and if we are content to use chemical disinfectants without heat, we must at times be in doubt whether these agents have penetrated into the interior of the strand. This is, after all, the chief difficulty, for, as explained above, in the process of manufacturing the catgut the intestines are cut into long strips, and these strips are plaited. It follows, therefore, that the germs are buried in the centre of the resulting cord, and whilst a scraping from the surface of prepared gut may give negative results in culture experiments, yet when the gut is buried in the tissues, and the heat and moisture opens up the central portions of the twisted cord, the germs that have up to this time lain dormant are liberated, and become foci of infection and suppuration. Zweifel found repeatedly masses of bacteria between the various strands that make up the end of catgut, and Brünner confirmed his observations.

It is for this reason that very thick catgut should never be used, no matter how prepared, No. 3 being the thickest that can be used and prepared with safety.

When the raw catgut comes from the manufacturer it is unfit for use, not because it is infected, but because when buried in a wound the heat and moisture of the tissues would so speedily soften it that it would become pulpy, and the knot would not hold. Therefore, in preparing catgut for use as a ligature we must keep in view the following points: It must be made aseptic, not only on its surface, but in its depths; its tensile strength must be such that it will stand sufficient strain to be tied effectively; it must be sufficiently seasoned to retain its form and tenacity so that it will not become untied, and will be able to resist absorption for several days or weeks, if necessary.

In order to achieve such results it will be advantageous to consider the researches of Minervini.* He has recently made an elaborate study of catgut, and his results are as follows:

* *Therapeutic Gazette*, December, 1899.

With regard to the tensile strength of gut he found that alcohol (75 per cent.) does not materially change it, but if a weak solution be used it lessens its strength very much ; absolute alcohol makes the gut very hard and stiff, and difficult to tie, and chloroform, ether, and xylol have the same effect.

Glycerine weakens gut slightly, as also does formalin in 1 per cent. to 10 per cent. solutions, while chromic acid of a strength of ½ to 2 per cent. diminished the strength of the gut slightly. If stronger solutions of chromic acid are used, the gut becomes much weakened.

Olive-oil and oil of juniper make it more elastic ; these oils do not weaken it, and when the gut is tied the knots hold well.

With regard to the effect of heat on the gut, Minervini found that boiling alcohol did not lessen its strength, but as it made the gut extremely stiff it was difficult to tie, and the knots did not hold well.

Boiling ether and chloroform and weak solutions of alcohol markedly weaken gut.

Turpentine, xylol, and other media which boil above 100° C. weaken the gut very much. The effect was not so marked if the water had been previously removed from the strands of gut.

Gut prepared by the formalin process and boiled in water is made weaker, but the knots are easy to tie, and do not exhibit a tendency to loosen.

His conclusions with regard to the effect of heat under pressure on the strength of the gut are as follows :

Catgut can stand dry heat up to 150° C. without alteration ; at or about 163° C. marked alteration occurs.

Water weakens gut, whilst boiling water disorganizes it completely ; but formalin and chromic acid can prevent this destructive action of water.

Any fluid that boils below 100° C. will not harm gut, provided the fluid contains no water ; and if the gut has been freed from water, fluids like xylol and cumol may be raised to a temperature of 150° C. without injuring the gut, but beyond 160° C. the gut becomes ruined.

With regard to the various disinfectants that are used in accomplishing absolute sterility of the gut, Minervini finds that alcohol, ether, chloroform, and carbolic acid at the ordinary temperature are quite unreliable.

Oil of juniper rendered gut infected with staphylococci free

after three days; but gut infected with anthrax was not free until thirty days had elapsed. Oil of juniper, however, when heated to 130° C., sterilized gut in thirty minutes.

Bichloride of mercury (1 in 1,000) was effectual against anthrax and pus germs in one hour; if, however, the mercury was dissolved in alcohol or ether, the solution required twenty-four hours to produce the same effect.* A 4 per cent. formalin solution also took twenty-four hours to destroy the anthrax bacillus, but a 1 per cent. solution destroyed the staphylococcus in six hours, and a $\frac{1}{2}$ per cent. solution of chromic acid destroyed the same germ in an hour, while a 1 per cent. solution of the same substance was effectual with anthrax in six hours.

Minervini found that carbolic solutions made with alcohol were unsatisfactory, and that all the methods that depend on the action of carbolic acid are unsatisfactory. He found, however, that gut that was carefully prepared with sublimate, formalin, chromic acid, and oil of juniper could be relied on and was sterile, and that the gut prepared with formalin and oil of juniper is more rapidly absorbed than that subjected to the action of sublimate and chromic acid.

The results arrived at by Minervini correspond closely to the practical experience of many operators, as will readily be seen if the methods of preparing gut are compared with Minervini's results.

Preliminary Cleansing of Catgut.—Raw catgut when purchased is always found to be greasy, since it is oiled before it leaves the factory. Whatever method we intend to adopt in the preparation of gut, the first step must always be to rid it of grease or oil. This may be accomplished either by soaking the gut for some days in ether,† or by scrubbing it with a brush and soft soap, after which it is rinsed in cold water.

The most useful sizes of catgut range from 0 to 3; these four sizes will fulfil all the requirements that catgut can be used for,

* Mixtures of pure chemicals with absolute alcohol are inert; a small quantity of water, however, enables the chemical to act. Salzwedel and Elsner, working in Koch's laboratory, found that the bactericidal action of alcohol itself was best exerted in strengths of 50 to 55 per cent.

† Rice remarks: 'Fat may be removed within an hour by boiling the gut with enough ether to cover it completely. . . . Since the gut, even though boiled in ether, still retains at least as much fat as the amount of ether in the interior of the gut can hold in solution, it is best to boil it again in absolute alcohol' (Bryant, 'Operative Surgery').

and when the necessity arises for a stronger gut than No. 3, then it will be wise to trust to some other material than catgut.

The catgut is cut into lengths of 12 or 18 inches. Nos. 0 and 1, being usually used for ligatures, may be 12 inches long; No. 2, being very useful for sutures, may be 18 inches; while No. 3, which will be used for tying pedicles and for abdominal wounds, may be divided into lengths of 12 and 18 inches.

This plan of dividing catgut into lengths is one that saves time at an operation, and in the end is the most economical. Each number is kept in a stock jar, from which we take as many pieces as we may require with a pair of sterilized forceps. By this means the gut need never be handled until the operator wishes to use it. In the formalin process it is not, however, possible to divide the gut before it is prepared; it may, however, be divided afterwards.

In hospitals the gut after being received from the maker is usually wound on glass or metal spools. The only objection to this plan is that the innermost layers of the gut are not acted on to such advantage as the outer layers, being in a sense covered up and protected by the outer layers.* The second objection to a spool is that the operator or assistant generally holds the spool in his hand to unwind the gut at the time of the operation, and so unnecessarily contaminates it. This objection can be overcome by having a small metal box made with a pivot through the centre, so that the reel of gut can be slipped into the box. A slit in the side enables the gut to be drawn out as the reel readily revolves on the pivot; thus the hand does not come into contact with the gut.

Glass boxes and jars are also constructed which hold several reels, so that catgut of any size may be always at hand.

Should a reel of catgut become contaminated by pus at an operation, the gut must be thrown away after the operation. Any reel of gut that is handled at any operation should be re-sterilized.

The Methods of sterilizing Catgut—1. Lister's.—This method of preparing gut with carbolic oil is absolutely unreliable, and need only be mentioned to warn operators that the gut that is bought in shops prepared by this

* The gut may be first prepared and wound on the glass reels after the hands have been covered with a pair of rubber gloves.

method will not unfrequently give colonies of germs when culture experiments are carried out with it. Koch has conclusively shown that an antiseptic dissolved in oil may lose almost all its antiseptic action.

2. **Martin's Oil of Juniper Process.**—(1) Soak in ether. (2) place in 1 in 1,000 solution of sublimate in water; leave for twenty-four hours. (3) Place in a solution of 2 parts of absolute alcohol and in 1 part of oil of juniper; leave for twenty-four hours. (4) Transfer to similar solution and leave fourteen days. The gut is then ready for use.

Martin, of Berlin, uses this gut exclusively; it is very agreeable to work with, being very easy to tie, as the gut is soft and limp, and it does not slip through the fingers. Pozzi and Macnaughton-Jones praise this gut, and we have often used the following modified method of preparing it with excellent results:

3.—(1) Arnold's carbolic oil gut is taken and divided up into pieces 12 or 18 inches long. (2) Each size is placed in a jar of ether and left for fourteen days. (3) Immerse the gut in an alcoholic solution of iodic hydrarg. made up as follows: Water, 200 parts; absolute alcohol, 800 parts; iodic hydrarg., 1 part. (4) Leave the gut in this solution for twenty-four hours; then change it to a similar solution, and leave for forty-eight hours; then change to a similar solution,* and leave for fourteen days. (5) Transfer to oil of juniper (1 part), absolute alcohol (2 parts), and keep until required. (6) At the time of the operation the gut may be placed in a bowl with a little absolute alcohol.

In preparing gut we use Burroughs Wellcome's soloids of mercuric potassium iodide, which are coloured pink; this colour soaks gradually into the gut, so that by stripping up the strands comprising a cord or gut we can easily ascertain if the solution has penetrated to the centre of the cord.

If we wish for a gut that will remain unabsorbed for several weeks, this is easily prepared by transferring the strands from the iodic hydrarg. solution to a 2 per cent. chromic acid watery solution for thirty minutes, after which it is placed in a 20 per cent. sulphurous acid solution for twenty minutes. It is then washed in cold sterilized water and preserved in alcohol.

* We generally have this last solution slightly warmed to allow the solution to penetrate more easily.

One point requires to be attended to in preparing gut with juniper oil. There are **two oils** of juniper, one known as the oleum juniperi ligni, the other derived from the berries, and called oleum juniperi baccarum. Martin used to lay great stress on the point that the **oil of juniper wood** was alone to be employed, and therefore the directions given by Gerster* are entirely wrong, for he particularly directs that the ol. juniperi baccarum is to be used.

Sublimate Methods.—4. **Bergmann's.**—(1) Immerse the gut in the following solution: Alcohol, 800 parts; distilled water, 200 parts; sublimate, 10 parts. (2) Leave the gut in the solution for twenty-four hours, then change to a fresh solution of the same strength, and leave for another twenty-four hours; then change to a fresh solution, and again leave for twenty-four hours. (3) Preserve the catgut in absolute alcohol, to which 10 per cent. of sterilized glycerine may be added if a softer form of gut be required.

5. **Esmarch's.**—(1) Clean the gut with soft soap and water. (2) Soak in 1 in 1,000 sublimate solution for twelve hours. (3) Soak in 1 in 200 sublimate solution (in alcohol) for twelve hours. (4) Preserve dry in tightly closed glass vessels. (5) Before using, place in a vessel with an alcoholic (1 in 2,000) solution of bichloride of mercury.

Lockwood, who used this method at one time for preparing his catgut, says that the perchloride may be advantageously replaced by the biniodide of mercury, and in his latest writings he adopts the biniodide.

6. **The Alcoholic Method.**—(1) Roll the catgut on spools and place it in a jar, the top of which fits very perfectly, and is held in place by a bar, which admits of the top being firmly held in position by a powerful screw (Fig. 31).† (2) Partly fill the jar with alcohol, screw on the top, and immerse the jar in boiling water for one hour. (3) Repeat the process on the following day. (4) Preserve in alcohol.

There is considerable doubt whether boiling alcohol will sterilize gut. Pilcher‡ says that he has used alcohol-prepared gut for years with complete satisfaction, and it may be noted that the gut that he uses is not prepared under pressure.

* 'The Rules of Aseptic and Antiseptic Surgery,' p. 8.
† McBurney, 'International Text-book of Surgery,' vol. i., p. 276.
‡ Pilcher, 'Treatment of Wounds,' p. 115.

Frederick* condemns the process, and says all methods are defective which have for the basis of sterilization of catgut the boiling of it in alcohol.

Another method of boiling gut in alcohol is as follows: A brass jar is constructed with a stopcock in the lid; on heating the jar the alcohol is vaporized and the air is expelled; the stopcock is then closed, and the jar is immersed in boiling oil for one hour.

7. **Cumol Method.**—(1) Place a glass beaker in a sand-bath, and cover the bottom of the beaker with a layer of cotton-wool. (2) Place the gut on the cotton-wool. (3) Cover the beaker with a piece of cardboard through a hole in which a thermometer projects to the centre of the beaker. (4) Heat the beaker to 80° C. so as to drive off all the moisture from the gut; this heat is maintained for one hour. (5) Remove the beaker from the

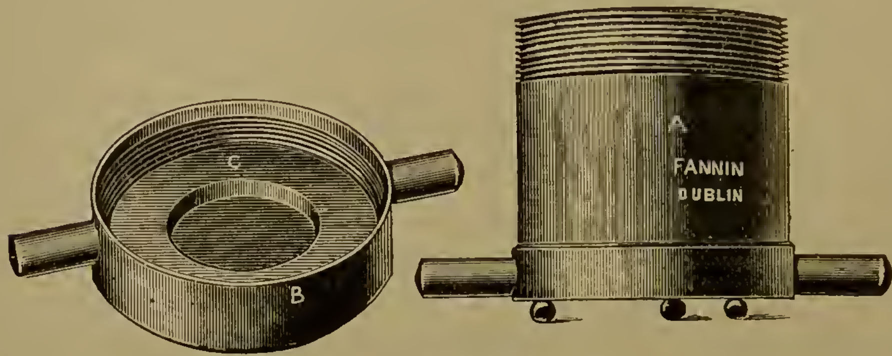


Fig. 31.—Catgut Sterilizer.

sand-bath, and pour into it cumol heated to a temperature of 100° C. (6) Place the beaker in the sand-bath and cover it with the cardboard, and raise it to a temperature of 165° C. by means of two Bunsen burners; maintain the temperature for an hour. (7) Pour off the cumol, and allow the catgut to dry in the beaker in the sand-bath at a temperature of 100° C.; this drying will not be complete until two hours have elapsed. (8) Transfer the catgut with sterile forceps to test tubes, where it is preserved dry; it may, however, be kept equally well in alcohol.

This method is much praised by Kelly, and he describes a special apparatus for preparing catgut by cumol, as cumol is not explosive, but is very inflammable.

8. **Formalin Method.**—(1) Take a glass spool, and notch each flange with a triangular saw file. (2) Wind the gut on the spool,

* *American Journal of Obstetrics*, vol. i., p. 337, 1899.

leaving an end to pass through the notch in one flange and an end to pass through the notch in the other flange, and then to be carried through the hollow axle of the spool so that both ends can be tied in a secure knot by first tying the gut in a single knot, then in a double knot. (3) Place the spools in a 3 per cent. formaldehyde solution, and leave according to the size of the gut. No. 0 remains in for one hour: No. 1 three hours, No. 2 five hours, No. 3 seven hours. (4) Remove the gut from the formalin solution, and wash it in running water for twenty-four hours. (5) Boil the gut in water for fifteen minutes. (6) Preserve the gut in alcohol mixed with 10 per cent. sterile glycerine.

The secret of success in this process is to keep the gut in a high state of tension until after it is boiled, for the process causes the gut to contract forcibly, and if it is allowed to shrink it will be useless. Another important point to be observed is, that one strand of gut must *not overlap another;* should this happen the lower strand will not be properly hardened by the formalin, and a weak spot will result, so that when the gut is boiled it will become gelatinized, and it will be useless.

In order to prepare the gut successfully a frame made with teeth should be procured; the gut is then wound on this framework, and the teeth prevent the individual strands from overlapping.

It should be noted that formaldehyde is sold as a 40 per cent. solution; one part of this in 12 parts of water gives us the required strength for our solution.

Chromic Acid Method.—(1) Wind the gut on the spools in the same way as described above for the formalin method. (2) Place the spools in the following solution: Bichromate of potassium, 23 grains; glycerine, 2½ drachms; carbolic acid, 2½ drachms; water, 1 quart. (3) Leave for twenty-four hours; then remove, and allow to drain and dry for three hours. (4) Then place in the formalin solution, and prepare by the formalin method.*

The Bichloride of Palladium Method.—(1) Place the gut in ether for forty-eight hours. (2) Transfer to the following: Sublimate, 40 grains; tartaric acid, 200 grains; alcohol, 95 per cent., 12 ounces. (3) Allow the gut to remain in this solution according to its size; thus No. 1 will remain five to seven minutes, No. 2 ten to fifteen minutes, No. 3 twenty minutes, No. 4

* Frederick, *American Journal of Obstetrics*, vol. i., p. 335, 1899.

twenty-five minutes. (4) Transfer the gut with sterile forceps to jars of alcohol (95 per cent.) containing palladium bichloride in the proportion of $\frac{1}{16}$ grain (2 drops of a solution which contains 15 grains of the salt to the ounce) to a pint of alcohol.*

Wallaby Tendons. — We who live in Australia can procure the tendons of the wallaby and the kangaroo with some degree of ease, and it is therefore of advantage to know any exact method of preparing these very useful and excellent sutures, for they are now used very largely in closing the abdominal wound. In comparison with catgut these tendons possess certain obvious advantages: they are aseptic when first obtained, and with a little care may be kept aseptic; they are very strong and easily tied, and are more slowly absorbed than catgut when prepared with chromic acid. The directions here given are based on the experiences of Dr. Morgan† of Melbourne, Professor Watson of Adelaide, and of my colleague, Dr. Barrington.

The animals from which the tendons are obtained are the rock wallaby (*Petrogale penicillata*), and the scrub wallaby (*Macropus greyi*), and the great kangaroo (*Macropus giganteus*).

For gynæcological work the tendons of the rock wallaby are the most useful; for the tail being long and thin, the tendons are likewise long and slender.

In order to remove the tendons, the tail in a fresh condition is taken and cut off close to the body. It is skinned by making a longitudinal incision through the skin to the superficial fascia from one end to the other of the under surface of the tail. Dissect up a portion of the skin from the proximal end of the tail, and then seize the skin in one hand and the proximal end of the tail in the other, and strip the skin off. Next take a pair of strong pincers which have been boiled in soda solution, and seize the tail at the last intervertebral cartilage, and crush this through, at the same time with a slight twist break the intervertebral ligaments; then, with the tail in one hand and the pincers in the other, pull with gradually increasing force until you feel the tendons tear out from their muscles—they will then come out quite easily.‡

* Keen, 'Annals of Surgery,' vol. i., p. 49, 1898.

† Morgan, 'The Preparation and Uses of Kangaroo and Wallaby Tendons' (*Australian Medical Gazette*, July 20, 1898).

‡ Morgan, *loc. cit.*, p. 307.

After this they should be cut off close to the vertebræ, and dropped into a solution of equal parts of methylated spirit and water. This process is repeated with each succeeding vertebra.

The synovial sheath may be removed, but Professor Watson contends that the synovial sheath is better left on, as it preserves the contour of the tendon. The sheath is stripped off by taking each tendon separately and running the finger and thumb along from insertion to origin, the latter being distinguished from the former by a small piece of muscle which generally remains attached to the tendon after drawing it out.

The tendons are further prepared in the following way by Dr. Barrington: (1) Place in 1 in 1,000 biniodide solution (with excess of potassium iodide) and spirit (equal parts of biniodide and spirit 1 in 500 and cold boiled water) for one to six hours. (2) Desheath each tendon and sort them as to thickness. (3) Keep in good spt. vini meth. or spt. vini rectif. (4) When about to use place those needed in a solution of 1 in 500 biniodide and spirit for fifteen minutes, and then in absolute alcohol.

Sulpho-Chromicized Tendons.—After 3 (above): (4) Place in 2 per cent. chromic acid watery solution for thirty minutes. (5) Pour off chromic acid solution and place in 20 per cent. sulphurous acid; constantly shake the vessel for twenty minutes until the tendons are **green right through.** (6) Wash well and at once, in cold sterilized water. (7) Dehydrate in biniodide spirit (1 in 500) for five minutes. (8) Preserve in absolute alcohol.

If the tendons cannot be removed and treated immediately, the tails may, in cold winter weather, be packed in boracic acid, and they will remain fresh for several days. This plan is much to be preferred to allowing bushmen to draw the tendons with their dirty fingers or teeth, after which they hang them on a rail to become dry and septic.

Reindeer Tendon.—Greife* has shown that tendons obtained from the neck of the reindeer can be easily sterilized, and make excellent ligatures. They consist of parallel fibres of connective tissue, with a small intermixture of elastic fibres. He prepares them with ether, juniper oil, and sublimate, and found them satisfactory in 450 section cases.

* *Münch. Med. Woch.*, June 18, 1901. The price of these ligatures is three shillings per thousand threads.

Silk.

No one material is so useful in section work for ligatures and sutures as silk.

A thread of silk when compared with a thread of catgut of the same thickness is always stronger, more easily tied, and less liable to slip when tied, while, above all other considerations, it is easily sterilized. The objections to silk are that it is not absorbed, and so may be the cause of a fistulous tract which will not close until the offending silk is removed; and, indeed, it may give rise to suppuration months after it has been buried in the tissues, when we may have imagined all trouble at an end. But notwithstanding these objections, silk remains the favourite material for pedicles, and it will continue to be so until a material is manufactured less absorbable than catgut and more easily disinfected.

Having selected silk as a ligature material, the next point for consideration is the size and variety to be employed.

The silk used by surgeons is sold under the title of **Twisted, Braided,** and **Floss** silk.

The first variety is round and stiff, like whip-cord, whilst braided silk is flat and limp, and floss silk is soft and round, and is only twisted enough to keep it together.

Twist Silk is not a pure silk, and the article most commonly used for surgical work in the present day, and known as 'Pearsall's Twist,' though it has a silk finish, really contains no silk whatever. It is extremely strong, and is known in the trade as 'Dentist's Twist'; it costs nearly as much as pure silk, and it evidently is a satisfactory article, as it has held the market longer than any other twist ligature.

Braided Silk is woven, and generally with a percentage of cotton. It is not much used by English surgeons, but it is popular with many operators on the Continent. We used it almost exclusively in 100 cases for closing abdominal incisions, and we have used it frequently in performing excision of the breast, and in closing incisions after kidney operations. Our experience of it was that it could not be left in superficial wounds for more than eight days; if continued beyond that time the skin round the suture became red, and often on removing the suture, even as early as the seventh day, a drop of pus could be squeezed out of the tract. We might mention that Mr. Tait

generally closed his abdominal wounds with silk. We have ceased to use braided silk now, for unless the silk is very thick (No. 9 and upwards) it breaks very easily after being boiled; in fact, the lower numbers of braided silk are *most unreliable*, and break with the slightest strain. On the whole, braided silk possesses no virtues that silk does not, and it possesses many disadvantages, so that it is not necessary, or even advisable, to provide this material for section work.

Floss Silk, as used in surgery, is a perfectly pure silk, and is only twisted sufficiently to keep it together. It is soft and easily unravelled, and although ligatures of floss silk are considered to be the strongest of all ligatures, we do not think the smaller numbers stand the strain that the best twist ligatures do. After using floss silk for a variety of pedicles, we certainly think that it is much less liable than twist silk to cut through soft and inflamed tissues. It is made generally in six sizes. As to the size of silk that should be used opinions differ widely.

There are those who think that very thick floss silk is the best for pedicles, whilst others—and apparently the majority of operators—are now discarding thick silk in favour of the thinnest silk * that will stand the strain in tying off a pedicle. This difference of opinion is largely due to the change in technique, for whereas in former years it was the universal practice to transfix the broad ligament below and tie off the whole mass with interlocking ligatures, now it has become a very general practice to tie the ovarian and uterine vessels separately, leaving the intermediate space of broad ligament free. In carrying out the first plan it was often necessary to embrace a very large mass of tissue, and consequently much force was required in tying the ligatures so that they should not slip after the tissues have been compressed and had begun to shrink. By adopting the newer method a much smaller mass of tissue is included in the ligature, and much less force is applied, and consequently a much thinner cord is now required.

It will be wise to provide the following sizes of surgeon's twist: Fine (No. 1), intermediate (3 and 4), heavy (5). Besides these numbers, it is well to have a large-sized floss silk for soft, rotten pedicles such as one often encounters in removing pus tubes.

* 'The thinnest silk compatible with safety, the smallest knot, and the least possible handling of the pedicle, is the most perfect surgery' (Greig Smith).

We were at one time very fond of thick floss silk, and we used it in about 100 section cases. We never had any trouble or bad results with it when the abdomen was closed without a drainage-tube. In a case of ruptured tubal pregnancy and in a case of pyosalpinx where a glass drainage-tube had been left in for some days, a sinus was established, which did not close until the offending silk ligature had been removed, in the one case five weeks after the operation, and in the other case a year after. These, however, were the only two cases in which we had any trouble whatever with thick silk ligatures, and it is probable that the infection in both cases was introduced through the drainage-tube. Such satisfactory results from the use of silk we attribute to the fact that we always soak all silk in iodic hydrarg. or sublimate solution (1 in 500) for an hour before we operate. Our reason for this is that if sterilized silk be taken from a bottle and examined before being handled no germs are discovered, but if the silk is run through the fingers after the operation has been in progress for some time it is seldom found to be sterile ; consequently, when buried in the tissues it may give rise to trouble later on, and if one of these sutures be examined months after the operation the knot will be found to contain germs. If, however, we soak the silk in a sublimate or iodic hydrarg. solution before an operation, the silk may be pulled through the hands during the course of the operation and yet remain sterile, or at least give no positive results in culture media. We generally now employ Nos. 4 and 5 twist silk for pedicles.

Method of sterilizing Silk.—Halsted's method is the one that is now in much favour. The silk is cut into lengths of 12 inches, or longer as required, and a dozen of these sutures are wound on a glass reel. Several reels thus prepared are placed in a glass ignition tube, and the ends plugged with cotton-wool. The tubes are placed in a steam sterilizer, and steamed for an hour on the first day and half an hour on two successive days ; the silk is then ready for use.

A few points should be noticed in preparing silk by Halsted's method.

1. Absorbent cotton should not be used if the tubes are to be stored, for the plug takes up moisture from the air, and fungi will be more likely to grow through it if it be kept for any length of time ;* cotton batting is the best material to use for the plugs.

* Robb, *American Journal of Obstetrics*, May, 1900.

2. The cotton plug should be only loosely placed in the tube during the sterilizing process, so that the steam may penetrate with facility. This point should be particularly attended to if the sterilizing is done in an apparatus in which the steam is not under pressure. After the process is complete the cotton-wool should be tightly pressed into the tube so as to form an effectual plug.

3. In removing a glass reel from the tube, be most careful that the cotton which comes into contact with the tube does not touch anything, lest it should be infected before it is replaced in the tube.

4. In order that the ligatures will not fray and become unravelled, the ends of the pieces on the reels should be tied together.

Those operators who are accustomed to tie off the broad ligament by the interlocking of two ligatures should cut their silk 36 inches long; when introduced and divided this will give two interlocking ligatures each 18 inches long. For economy's sake two such ligatures only should be wound on a glass reel, and this will often be quite sufficient for dealing with both broad ligaments, whether the interlocking method is used or whether the ovarian and uterine ends of the ligament are tied separately.

Lockwood prepares his silk by rolling it on a glass reel or a microscope slide, and then boiling it; the small sizes are boiled in water for fifteen minutes, and the large sizes for thirty minutes. He then places the silk so prepared in a $2\frac{1}{2}$ per cent. solution of carbolic lotion.

We do not, however, keep silk in any fluid after boiling it, but always dry it; for if we wish to keep silk in stock after disinfecting it, we should not preserve it in any fluid, for we have repeatedly found that even the largest size floss silk if kept in carbolic solution becomes rotten after a month.* It is much better after boiling the silk, either in water or in a 5 per cent. carbolic solution, to dry it, and in this state it will keep for years. The method we adopt in drying silk we shall describe at length in a later chapter when speaking of the preparation of ligatures by the surgeon at his own home.

For use in hospitals where sections are being daily performed, a glass jar (Fig. 32), or Greig Smith's reel-holder (Fig. 33), will

* Silk will keep well in alcohol, but the thick twist silk becomes very stiff; it is tied with difficulty, and it cuts the tissues very easily.

be found very convenient for silk. He says, in describing the latter, that 'for holding these four varieties of silk [Chinese twist $\frac{1}{2}$, 2, 4, 6] I have had a stand made; it is very portable, and always ready for use. It consists of a solid rubber case, on to which is screwed a cap which keeps it practically air-tight. Into this case fits a leaden disc, which is heavy enough to remain stationary while the silk is being drawn out; and on this disc, supported by upright rods of metal, are placed the four reels. A glass plate, perforated in four places for the threads, is screwed

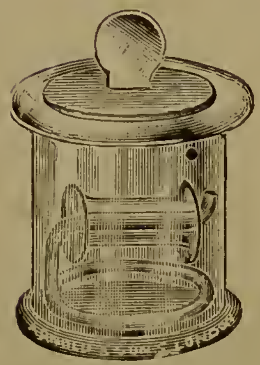


Fig. 32.—Ligature Bottle for Silk.

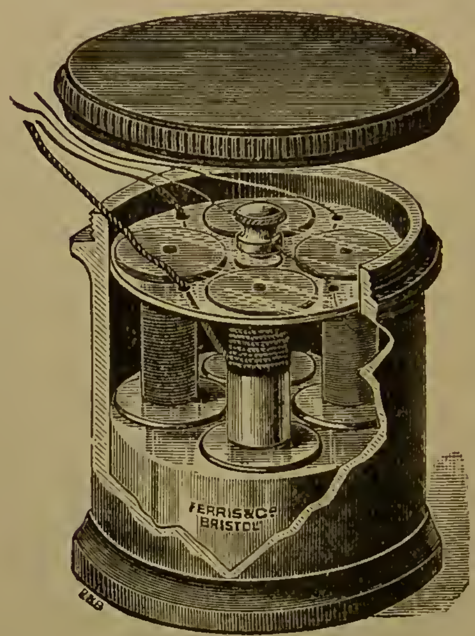


Fig. 33.—Greig Smith's Reel-Holder for Silk.

on to the top of a central bar. Before using it the leaden disc, with the reels and thread, is placed in boiling water for ten minutes, and then returned to its case, into which sufficient 1 in 20 carbolic lotion has been placed to cover the glass plate. . . . After being used, the lotion is poured out and the cap screwed on. The silk, treated and protected in this way, may be used daily, without further boiling, for several weeks.'*

Silkworm Gut.

To sterilize this material a dozen pieces are taken, and, after being twisted into a loose loop, are inserted into a glass ignition tube, whose ends are then loosely plugged with cotton-wool. The

* G. Smith, 'Abdominal Surgery,' vol. i., p. 84.

tube is then placed in the steam sterilizer, and the disinfection is carried out in the same manner as the disinfection of silk by Halsted's method.

A quicker way, and one that we always follow, is to pick out from a bundle the strongest-looking pieces, and try the strength of each strand by putting a considerable strain on it. Each strand is then cleaned by being drawn through damp cotton-wool. Then trim off the crinkled ends, and tie the number of pieces required into a loop. The gut is now placed in a beaker of boiling water over a sand-bath, and allowed to boil for ten minutes. By means of a pair of sterilized forceps the bundle of strands is transferred to a stoppered bottle, and kept thus until required. Ten minutes before using the gut it should be placed in hot water or carbolic solution (3 per cent.), so as to make the gut more flexible.

We do not agree with those who say that silkworm gut keeps well when soaked in a carbolic solution, or even in alcohol. We have usually found that it becomes brittle and breaks easily. It is always safer to preserve it dry.

With regard to its use in section work, silk gut is universally acknowledged to be a perfect superficial suture material, though it does not do well as a buried suture. It is strong and smooth, it is unirritating, and from the manner of its manufacture (it is made from the silk-glands of the worm when those glands are rolled between the finger and thumb) it has no capillarity, and therefore the fluids of the wound cannot soak into its substance.

It is placed in the market in bundles of one hundred, but not more than seventy-five threads of a bundle will be found strong enough to stand the strain of tying if the abdominal walls are thick. Recently small boxes containing a hundred picked strands have been brought out; these are classed as fine, medium, and coarse, and the latter kind we always use now in closing the abdominal wound.* These thick strands are, however, very stiff, and must be soaked for some time in hot water before being used, and in tying them we may adopt the suggestion of Treves, who says: 'If a knot be attempted and be pulled tight, the thread is almost certain to snap . . . the suture is secured

* G. Smith used to say that he got the best gut at the shops of good fishing-tackle makers, but even then he did not get more than twenty threads out of a bundle that would stand a great strain. Tait obtained his silk gut from Wilson, Quay de Louvre, Paris.

by making use of the first stage of the surgeon's knot . . . the second noose should not be formed.'*

Silver Wire.

This material is now being used by many operators as a buried suture to hold together the divided fascia that covers the recti. Wire thus introduced may remain *in situ* for an indefinite period without causing any trouble.

The size of wire to be used is about No. 20 standard gauge, and in preparing it the wire should be first scrubbed with soap and water, and then boiled in sodium carbonate solution for fifteen minutes, or it may be heated in an alcohol flame; the latter method anneals the metal, and it does not break easily when twisted. Great care should be taken not to twist the wire in any way before introducing it, for though wire will stand a great strain in a straight line, it cracks easily when bent.

After being sterilized the wire may be preserved in a well-stoppered bottle or in a metal case.

Bronze Aluminium Wire is now often used in place of silver wire and silkworm gut in closing the abdominal incision.

Horse-Hair.

Many surgeons, not content with sewing up the abdominal wound with silkworm-gut sutures, insert between each gut suture coaptation horse-hair sutures, so as to insure perfect apposition of the skin edges, thus aiding rapid healing and preventing infection.

To prepare horse-hair it is first cut into foot lengths, and well washed with soap and water; it is next placed in alcohol and allowed to soak for twenty-four hours, after which it may be sterilized with steam in a similar manner to silkworm gut, or it may be boiled for fifteen minutes in 3 per cent. carbolic solution and preserved in this. It will not rot provided it be not kept too long. However preserved, it should be placed in a warm carbolic solution (3 per cent.) before using, as this makes it very elastic.

* Treves, 'Operative Surgery,' vol. i., p. 44.

CHAPTER V

THE PREPARATION OF SPONGES, WOOL, AND GAUZE

The Preparation of Sponges.

At one time no surgeon attempted a section without having a goodly supply of sponges at hand. Then came a period of reaction, when many abandoned sponges for sponge-cloths, and now again sponges are in favour.

The reason for the preference for sponges is easily accounted for when one has used both sponges and sponge-cloths. The elasticity, softness, and superb absorbent power of the sponge cause it to stand unrivalled. But, unfortunately, there are draw-backs: sponges are difficult to sterilize; they cannot be boiled; and they are expensive.

When first obtained from the sea sponges are exposed to the air until decomposition has begun, after which they are beaten in running water to get rid of the soft gelatinous sarcode that surrounds the meshwork of interlacing horny fibres, strengthened by calcareous particles, which constitute the skeleton of the sponge. After the sponge is drained it is dried.

It will readily be seen that, if the preliminary process of removing the sarcode is imperfectly performed, when the sponge comes into the surgeon's hands he has to deal with a ball of germ-infected material, and before he can attempt to use such an article he must be most particular in its disinfection.

The first step is to pick out suitable sponges. For section cases we need two different shapes: the round or cup sponge, and the flat, leaf-like variety; the first to sponge with, the second to pack with, so as to isolate areas and prevent the intestines obtruding or being soiled.

In choosing sponges the surgeon should never select the large honeycomb sponges, for they are usually of very inferior quality

and tear easily, and after being used a few times are quite useless. They are, in fact, not Turkey sponges, but are imported from the Bahamas. The true Turkey sponge is the one most fitted for surgical work, and in selecting them choose those which have the smallest holes, which most nearly approach a ball in shape, and which are capable of being stretched in the crude state without tearing.

Cup-sponges of first-class quality are much easier to obtain than flat sponges, which are very prone to rot after being used several times, and then tear very easily when being removed from the abdominal cavity.

Having selected the sponges, the first thing to be done is to beat them to rid them of the sand which usually fills their meshes; for as these articles are always sold by weight, the dealers of the Levant lay the fresh sponges on the shore so that the ripple of the water may fill the pores with fine sand. In order to rid the sponges of the sand they may be placed in linen bags and beaten and pounded for a time. We have found that an effectual way is to run a skewer through each sponge, and beat it on a sheet of glass; after this they may be rinsed in warm water, which is changed until the water remains clear. Then proceed as follows:

1. When the sand has been removed, the pieces of coral and shells, and the calcareous particles which are contained in the meshes of the sponge, are to be dissolved by placing the sponges for twenty-four hours in a weak solution of hydrochloric acid (1 to 2 drachms of the strong acid to 20 ounces of cold water). This solution not only dissolves the lime-salts, but also bleaches the sponges to some extent.

2. Wash the sponges frequently in warm water (100° F.) until the water is no longer clouded by the washing.

3. Soak for fifteen minutes in a hot saturated solution of permanganate of potash.

4. Transfer to a hot saturated solution of oxalic acid for half an hour or longer, until no sign of the potash is to be seen.

5. Wash the sponges in lime-water. This may be accomplished by squeezing the sponges with the bare hands after they have been disinfected, or with the hands covered by sterile rubber gloves, or they may be squeezed in an enamel lemon-squeezer or flannel-squeezer.

6. Rinse in sterile water.

7. Immerse in 1 in 1,000 iodic hydrarg. solution for twenty-four hours.

8. Squeeze out of this solution and transfer to sterile jars containing carbolic solution (1 in 20).

After using the sponges at an operation some operators discard them, and this rule should always be followed if the sponge has been employed to mop up pus. If, however, the case has been a clean one the sponges may be disinfected and used again without danger.

In order that we may get as much blood out of the sponges as possible, at the termination of the operation they should immediately be placed in a hot soda solution. After soaking for ten minutes the sponges may be well squeezed, and placed aside to be prepared in the following manner:

1. The sponges are soaked for twenty-four hours in soda solution; the proportion that Tait always employed was 1 pound of soda to twelve sponges.

2. Wash the sponges free from soda in hot water. This is a wearisome task, and as Tait says: 'It takes several hours' hard work using hot water, squeezing the sponges in and out of water, and changing the water constantly. Leaving them to soak occasionally for a few hours in very hot water greatly assists in the cleansing.'

3. When quite free from blood, fibrin, and soda, they are placed in a hot saturated solution of permanganate of potash, and the process is continued as related in the first directions (3 to 8).

The number of sponges required at a section will vary with the nature of the operation. In a case of hysterectomy, when the intestines have to be walled off, or in a septic case, where we wall off to protect the field of operation, we shall usually require six flat and six round sponges.

It is a good plan always to start with the same number, and before commencing the operation let the nurse count the sponges in a loud voice, so that everyone present may note the number.

As it would be expensive and troublesome to prepare twelve sponges for each section, it is a good plan to use sponge-cloths for walling off the field of operation, and merely employ the sponges for mop work.

As the sponges are brought to the operation in a jar, the

number required should be taken out with a pair of sterile forceps. They are then placed in a dish containing hot saline solution and allowed to soak, so that the carbolic may be washed out of them.

At the time of the operation they may be managed by a nurse, who stands behind the assistant who is helping at the operation, or they may be managed by the assistant alone. The sponges may be handed to the assistant in a bowl of biniodide which insures their sterility, and also helps to keep the hands of the surgeon and his assistant aseptic. A sponge should be taken from the lotion, applied to the wound, and returned to the lotion.*

Gauze Sponges.—Greig Smith wrote that in his opinion 'the preparation and purification of sponges require the most careful and close attention,' yet, notwithstanding this, he considered that

Fig. 34.—Roll of Plain Gauze.

'artificial sponges and sponge-pads should be excluded from abdominal surgery, for inside the abdomen they are useless and dangerous.'

This opinion expresses the position taken up by many operators; but, on the other hand, many continue to use gauze sponges, and are quite satisfied with them. We ourselves are so satisfied that we have not used a marine sponge for the last three years, although we freely admit that when sponges are compared to gauze sponges the softness, elasticity, and great absorptive power of the former quite outshine the latter, whose value rests on the fact that they can be boiled, and therefore can be perfectly sterilized; they can be rapidly prepared; they cost very little;† they are never used at a second opera-

* Lockwood, *loc. cit.*, p. 185.

† The plain sterilized gauze, prepared by Elwood Lee, is sold in rolls of 100 yards, 1 yard wide, for £1 2s. (Fig. 34).

tion; they are most efficient for keeping back the intestines in pelvic operations. Their defect is that they do not absorb rapidly or efficiently.

Gauze sponges are best made in three sizes. The largest size sponges are used in cases of hysterectomy when the patient is in the Trendelenburg position, and when, after delivering the tumour, we insert our gauze towels, and completely shut off the intestines from the field of operation. These gauze towels should be about 12 inches by 9 inches. The next size should be 9 inches by 6 inches, and are used in operations when we have not got a large abdominal wound; they serve to wall off the field of operation. The smallest size gauze sponges are about 6 inches by 6 inches, and are used to mop up blood, and they can be used for all the purposes that small marine sponges are used for.

These gauze towels and sponges are made of ordinary butter-cloth or plain gauze. As the gauze is very thin, it is necessary to sew four or more layers together according to the size of the sponge, and it is well to have the edges turned in all round, and sewn with thin silk or strong white cotton, else small pieces of the gauze may be left behind in the abdominal cavity. Some operators take the precaution of sewing a piece of tape to one corner of these gauze sponges, so that when they are introduced to wall off the field the piece of tape is left outside, and a pair of catch-forceps is placed on it; the sponge is thus easily recovered, and is neither forgotten nor is there any delay in searching for it at the conclusion of the operation.

In order that these gauze sponges may be sterilized effectually they should be boiled for an hour, and then left to soak in a solution of biniodide (1 in 1,000) for twenty-four hours or more; they may be then preserved in glass jars either in biniodide solution or in a weak carbolic solution (3 per cent.).

Gauze Mops.—These small mops are made in different ways. A simple way is to take a piece of gauze 6 inches by 6 inches, and fold it into a triangle, the apex of which is held firmly in the fingers, while the two remaining angles are brought down to it, and then the three points are twisted, so that the result is a small fan-shaped mop with a short stalk.

Tupfers.—Another way is to place absorbent cotton or Berlin wool in the centre of a piece of gauze (Fig. 35). The edges of the gauze are then gathered up all round the ball of wool, and are tied by a piece of strong crochet cotton so as to form a short

stalk; these are sterilized by being placed in the steam chamber for an hour or two on successive days.

These mops are used at a section for cleansing the skin previous to the incision, and for swabbing up the blood which escapes before the peritoneal cavity is opened. They should

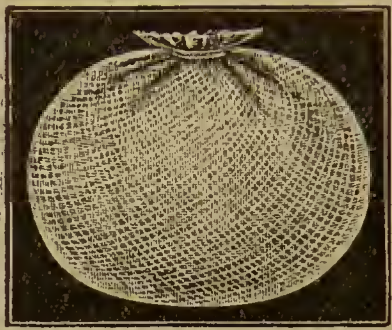


FIG. 35.—Tupfers.

never leave the surgeon's hand, for, being small and unnumbered, they may easily escape notice, and may be left behind.

They are certainly useful in cases where pus escapes, for after being used once they are thrown aside, and we thus save our small gauze sponges.

Cotton Bolsters.—Kelly says cotton bolsters covered with gauze are needed to hold back the obtruding coils of intestines in abdominal operations. They are made of non-absorbent cotton, which does not take up the moisture, and so preserves its elasticity. The cotton is prepared in rolls, 4 to 6 centimetres ($1\frac{1}{2}$ to $2\frac{1}{2}$ inches) in diameter, which are then cut in lengths of 12 centimetres (5 inches), and covered with gauze. They are sterilized in the steam chamber, and are stocked in glass jars.

Cotton-Wool.—Cotton-wool is procured in bales, or is bought in the familiar pound rolls. It may be cut into squares of various sizes and sterilized in the steam chamber in which it is allowed to dry; it is then transferred to air-tight metal boxes, from which it is lifted by sterile forceps when required. It is a good plan to enclose each square in a single layer of butter-cloth, as this keeps the cotton more compact. Three squares may be wrapped loosely in a towel and placed in the sterilizer, and three such squares (12 by 12) will generally be sufficient for dressing any section case.

Cotton-Wool Swabs.—Besides being used for dressings, cotton-wool may be useful for mops, and take the place of the gauze

mops described above. They are made by rolling a small piece of wool into a ball; the hands may be encased in rubber gloves during the process, or may be dipped frequently into biniodide solution. The swabs are placed in a glass jar, and after being sterilized are not allowed to dry, but are preserved damp for use. These swabs are used for cleansing the skin of the abdomen before and after the operation.

Gauze.—Beside being used for making gauze sponges, butter-cloth cut into squares is now frequently used for the first layer in the dressing of the abdominal incision, for making simple drains, or for the more elaborate Mikulicz drain.

Gauze Drains.—The simplest form of gauze drain is made by cutting the butter-cloth into a strip 2 yards long and 5 inches wide; this is folded so as to be 2½ inches wide, and then rolled up loosely like an ordinary roller bandage, and after being sterilized on three occasions it is dried and preserved in a glass jar.

Another form of drain is made by cutting the gauze into a strip a yard long and a foot wide; the gauze is then made into a roll about ¾ inch in diameter. This is preserved in shape, after being sterilized, by being doubled on itself and placed in a glass jar.

Mikulicz Drain or Gauze-Bag.—This is a very efficient form of abdominal drain. To construct such a drain a square of gauze is taken (12 by 12), and the centre is puckered up and tied firmly by a piece of silk twist, one end of which is left about 18 inches long. When in use the bag of gauze is inserted into the pelvis over the area to be drained in such a way that the silk thread is placed in the internal aspect of the bag. Pieces of iodoform gauze or of plain gauze are then stuffed into the bag, and their ends are left protruding through the mouth of the bag. In order to facilitate their removal it is well to tie a piece of tape on to each piece of gauze and mark a number on the tape; the various strips may then be removed in the inverse order in which they have been inserted.

Plain gauze is the best material for this bag, for even with weak iodoform gauze Pozzi states that he has seen signs of mild iodoform poisoning.

The strips of gauze may be removed after forty-eight hours, but Mikulicz prefers to leave the bag for four or five days.

In removing the bag the silk thread aids very materially by inverting the fundus of the bag.

Pozzi and others in using this form of drainage generally insert a large drainage-tube at the same time, in order to give central support to the tamponing, and prevent the accumulation below of fluids too dense to filter up through the gauze drains.

There is one precaution to be exercised in using this form of drain. The strips of gauze should not be stuffed into the bag too tightly, else the rectum will be so pressed upon that no flatus will escape, and a most uncomfortable distension of the bowels will occur.

This form of drain we can recommend, particularly in cases where the rectum has been torn on removing an adherent tube.

Lamp-wick Drain.—This was first introduced by Kehrer, and we frequently saw it used on the Continent. Kehrer prepared his wick by boiling it in a 5 per cent. carbolic solution, whilst others immerse the wick in iodoform and ether, after which it is dried and kept in glass jars. It is superior to gauze in its absorptive power; nevertheless, its use is more general in vaginal drainage after hysterectomy than in abdominal drainage.

Iodoform Gauze.—This material may be prepared by any of the following methods, all of which are excellent:

Billroth's.—Ten metres of plain gauze are placed in a large mortar, in which already there has been mixed 50 grammes of iodoform and the same quantity of glycerine, and to which has then been added 400 grammes of alcohol (95 per cent.). The only objection to this method of preparing gauze comes from the fact that the glycerine diminishes somewhat the absorptive power of the gauze.

Bergmann's.—Here no glycerine is used, for the sterile gauze is simply sprinkled with boiling water, and powdered iodoform is rubbed into its meshes with a gauze pad, and afterwards with a piece of glass shaped like a convex blotting-pad.

If we wish to use gauze in the vagina, or for a dry external dressing, we may rapidly prepare it by simply sprinkling it with crystals of iodoform, and gauze so prepared is as efficient as any made by the more elaborate methods. It would, however, be unwise to use such gauze for the peritoneal cavity.

*Keen** recommends the following method: 'Four ounces of each by weight of iodoform, glycerine, and alcohol, and 6 grains of corrosive sublimate are well mixed, and allowed to stand for three days. Moist bichloride gauze is then saturated with the

* Keen, 'Annals of Surgery,' vol. ii., p. 273, 1899.

emulsion, allowed to drip till almost dry, and is then kept in sterilized covered glass jars.'

Kelly's method is as follows: Iodoform gauze is prepared (with aseptic hands) by rolling plain sterilized gauze in 3-metre (about 3-yard) lengths, and then cutting up the roll into different lengths and breadths to meet the various requirements.

'Before dividing the large roll into these smaller pieces it is saturated with the following iodoform mixture: To 180 c.c. (6 ounces) of warm water, made into a good suds with Castile soap, add 45 c.c. ($1\frac{1}{2}$ ounces) of powdered iodoform, and mix it well in a clean basin with a glass rod. Then immerse the roll of gauze in the liquid, and work it with the hands until the iodoform has been completely taken up into the meshes of the roll. This is now sterilized three times in the steam sterilizer.'

Before using iodoform gauze prepared according to Kelly's directions, the iodoform should be washed out of the gauze, as the gauze is certainly too toxic. We lost a case from iodoform poisoning after using this gauze to wall off a gall-bladder. Lately we have had the gauze prepared with only one-third the amount of iodoform. Gauze thus prepared does not need to be washed before being used.

Iodoform gauze should never be used to drain any cavity—except the vagina—which has been swabbed out with peroxide of hydrogen, and the more firmly we pack the gauze against a raw surface the greater is the danger of toxic effects.

Rubber Drainage-Pads and Mackintosh Sheets.—Kelly has introduced a large sheet of rubber with an inflated rim, which is placed under the buttocks of the patient when she is lifted on to the table (Fig. 36). An apron extends over the edge of the table into a bucket, and carries away any fluids that otherwise would soil the sheets on the table.

Mackintosh sheets are placed under the linen sheet on which the patient lies on the table, whilst another is slipped under and over the blanket that covers the thighs and pubes of the patient; a third is sometimes placed over the chest.

Some operators cover the patient with a long mackintosh sheet, a hole being left in that portion that covers the abdomen; the edges of the opening are fastened to the skin with soap plaster.

Greig Smith always employed this long mackintosh sheet,

but it has little to recommend it to favour, and, as Lockwood remarks, it cannot be sterilized with certainty.

The rubber pads and mackintosh sheets should be well

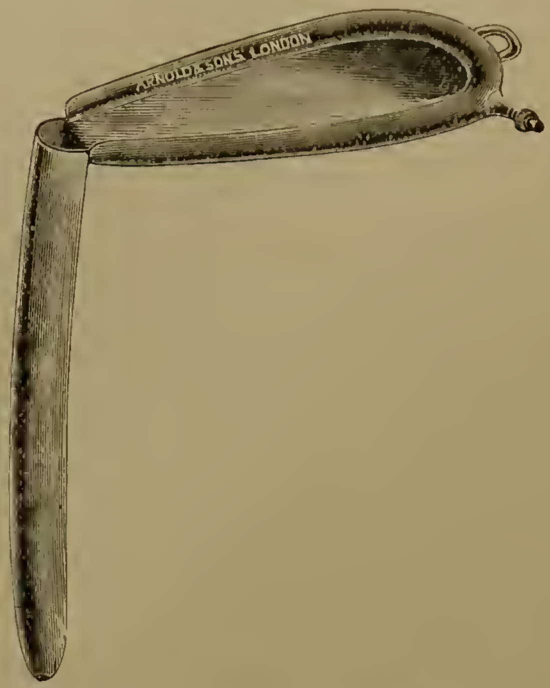


FIG. 36.—Rubber Drainage-Pad.

scrubbed with soap and water after each operation; if discoloured, they may be rubbed with an oxalic acid or an ammonia solution. If infected, they may be rinsed in 1 in 500 bichloride solution, or left to soak in a tub of weak carbolic lotion.

CHAPTER VI

INSTRUMENTS

The number of instruments that one requires at any section will, of course, depend upon the nature of the operation, for while an ovariotomy sometimes may be done with a scalpel and a needle, a hysterectomy may require two or three dozen instruments. It is certainly wiser to have too many than too few instruments; thus, by neglecting to provide ourselves at times with large pressure forceps we have been very seriously inconvenienced.

Whatever the nature of the section may be, the following instruments will be those generally required:

1. **Scalpel.**—The blade of the scalpel should be small, the handle thick and heavy, and made of metal. The sharper it is the better. A surgeon is more likely to do damage with a blunt than with a sharp knife. Greig Smith used to say that he had only one scalpel for all his operations, and that he never used to send it to be ground, but was accustomed to touch it up on a fine steel before each operation. Scalpels should be kept in aseptic metal cases.

2. **Scissors.**—One large, strong pair, with detachable blades bent on the flat, will be useful for dividing the parietes when enlarging the wound or for cutting through a thick pedicle. A small pair will be used for cutting adhesions and ligatures. In case of pelvic abscess a long pair with sharp points may be used in place of a trocar for tapping the abscess through the vagina.

3. **Hæmostatic Forceps.**—These may be of the pattern known under the name of Wells', Tait's, or Greig Smith's.

Wells' forceps differ from Tait's in having a broader end, and a spouting vessel is easily grasped because of this; but a ligature is more easily applied over the sharp points of Tait's instrument, as the outer surface of each blade is made very convex.

Greig Smith's forceps are shaped like Tait's, but the inside of the blades have grooves running parallel to the long diameter of the blade, not transversely. The originator says that they have more holding power than forceps of the ordinary pattern. In whatever direction they are pulled they will not slip, and if these forceps are left on the tissues as hæmostatics for a minute or two ligatures need rarely be applied to small bleeding-points.

Forceps must always be so constructed that the blades may be detached to be washed and sterilized.

For an ordinary section twelve of these small forceps will be sufficient, and these will be found very useful for grasping the ends of the sutures when silk-gut is used for closing the abdominal wound.

Fig. 37.—Tissue Forceps.

4. **Pressure Forceps.**—These forceps are constructed on the plan of Wells' hæmostatic instrument, but inasmuch as they are used for compressing large masses of tissue, they are made with blunt ends and powerful blades, which may be straight or curved to different angles. As one never knows what difficulty may be encountered, even in the most simple section, it is always well to have some of these forceps at hand.

For securing broad bleeding surfaces, such as we encounter after peeling off the omentum from a cyst, Thornton's T-bladed pressure forceps will be found very convenient.

5. **Dissecting Forceps.**—Two pairs should be provided, and if they are about 7 inches long they will be found more convenient than the usual short dissecting forceps. They may be so constructed that the blades can be slipped asunder when being disinfected.

6. **Long, Rat-tooth Forceps.**—Kelly says: 'I find a pair of long, rat-toothed forceps one of the most useful instruments in abdominal surgery, effectually taking the place of a hand deep down in the pelvis' (Fig. 37). They are especially useful in sewing flaps of peritoneum together after performing hysterectomy when we wish to sew the vesical peritoneal flap over the stump of the cervix to the posterior flap.

7. **Lister's Artery Forceps.**—A couple of pairs of artery forceps are very convenient for grasping the peritoneum before opening it or for holding it when about to insert the sutures for closing the abdominal wound.

8. **Ovum Forceps.**—Forceps constructed with long shanks and surmounted with a ring-end are convenient for grasping any mass of tissue, such as the collapsed wall of an ovarian cyst or the endocyst of a hydatid. These forceps may also be employed for sponges, or we may use special sponge-forceps.

9. **Retractors.**—The simplest and one of the most efficient forms is made from a strip of copper-plate $\frac{3}{4}$ inch in breadth

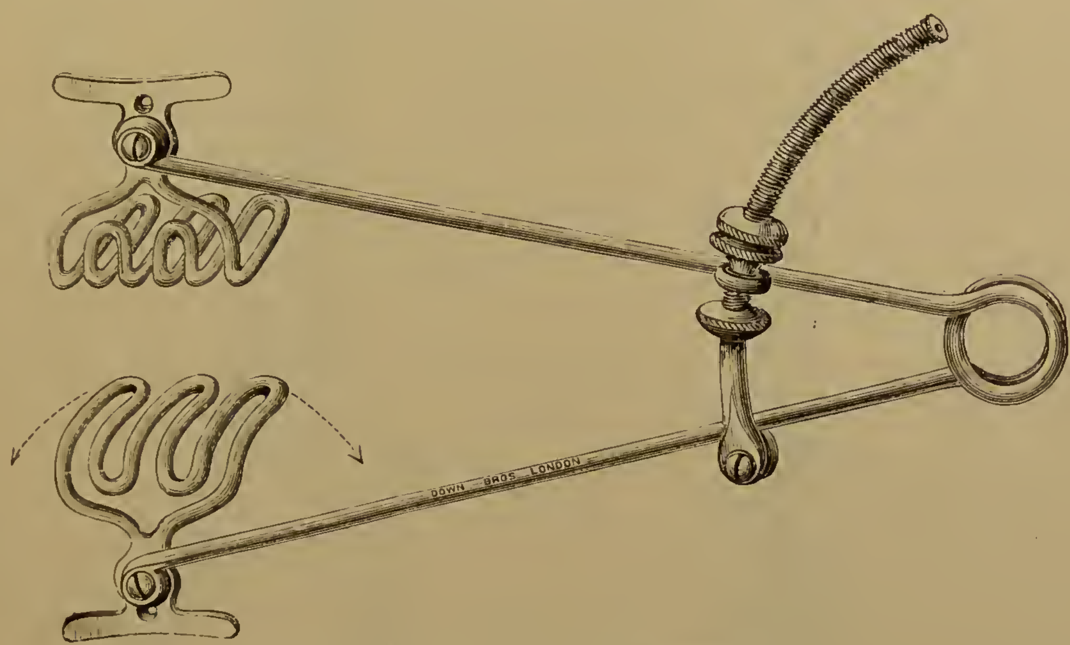


Fig. 38.—Maunsell's Abdominal Retractor.

and 9 inches long. Each end is bent, so that the whole assumes the form of a 'pot-hook.'

Other retractors, such as Doyen's, are made with a very broad, concave, curved extremity, somewhat resembling a short, broad vaginal speculum. These broad specula are employed to retract the muscular walls of the wound, so as to enable the operator to have a clear view of the depths below.

Should the surgeon be accustomed to operate by himself, or should he be short-handed, some form of self-holding retractor, such as Maunsell's (Fig. 38) may be employed with advantage.

10. **Pedicle Needle.**—To transfix the pedicle it is wise not to have a sharp needle, for we may easily puncture a large vein,

especially in operating on fibroids. A vein thus punctured may leak, and give rise to a broad ligament hæmatocele.

The best make to employ is one that has a shank 6 inches long fitted into a thick metal handle. As the shank approaches

Fig. 39.—Pedicle Needle.

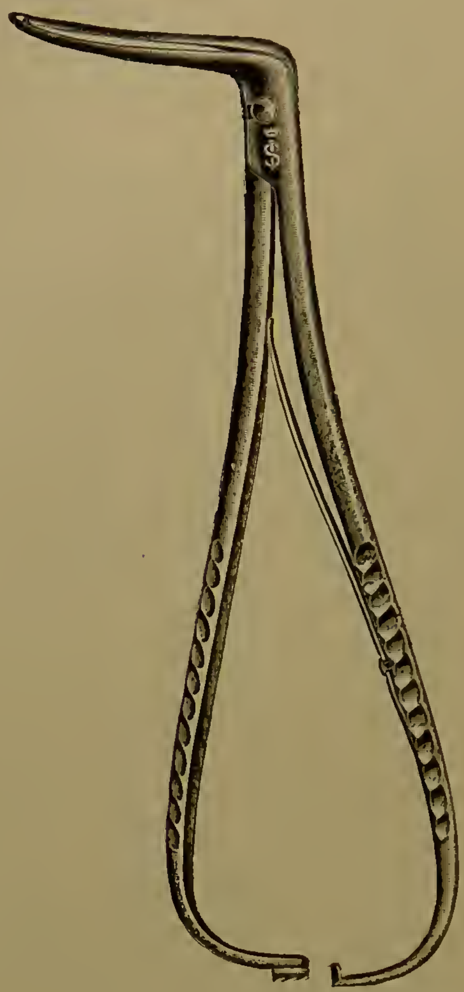


Fig. 40.—Cleveland's Ligature Forceps.

the distal extremity it should be bent into a slight curve, which has the eye almost at the extremity (Fig. 39).

Some operators prefer to push a special pair of curved forceps (Fig. 40) through the tissues, and to seize the thread, and then to withdraw the forceps. We have found this a very convenient method. Others, such as Kelly, use a suture-carrier, ' which is

a silk loop tied to the eye of a needle for the purpose of pulling interrupted sutures through in rapid succession.

11. **Needles.**—We may require ordinary surgical needles, round or curved, at any stage in a section, and it is always

FIG. 41.—Emmet's Needles.

FIG. 42.—Needle for introducing Sutures when closing the Abdominal Incision.

necessary to have a supply of plain, straight, and curved sewing-needles, in case the bladder or bowel should be torn. In selecting these plain needles, be careful to note the size of the eye. We have seen a young operator provide himself with an array of plain needles, and when he came to employ them he found that

the eyes were so small that it was impossible to thread them with fine silk. Darning-needles generally have a much bigger eye than sewing-needles, but they were always blunt.

The needles that we have found most serviceable are the curved Emmet needles (Fig. 41); the shank is round, but the point is trocar-shaped. These needles are exceedingly sharp,

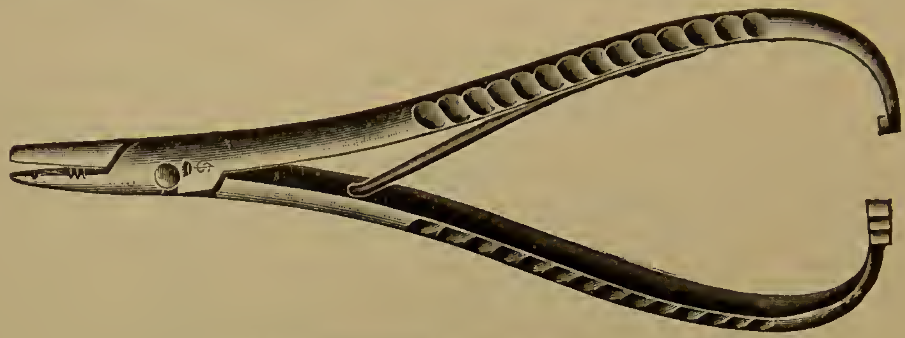


Fig. 43.—Mathieu-Kersten Needle-Holder.

and are very strong, and unless grasped near the eye, they will never break. Hagedorn's needles are excellent, and are particularly useful when tough tissues are encountered, or when fine work is required. If straight surgeon's needles are used for closing the abdominal wound, they should be at least 3 inches in length; but the young surgeon will find that a sharp handled

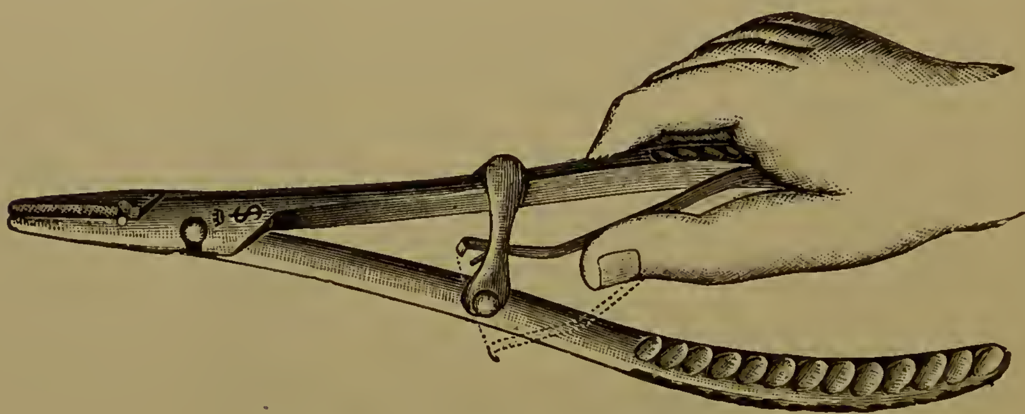


Fig. 44.—Reiner's Needle-Holder.

needle, with a curve towards the distal extremity, will enable him to work with great facility and rapidity (Fig. 42).

12. A good needle-holder is a great boon to any operator. Of the innumerable patterns that we have tried, we prefer to use the Mathieu-Kersten (Fig. 43). We also use Hagedorn's instrument, while the ingenious instrument of Reiner is an easy one to work with (Fig. 44).

If Hagedorn's needles are employed, a special holder will be required, as it is not easy to hold the thin edges of these needles in an ordinary holder, though this may be done with a Mathieu-Kersten holder after a little practice.

In closing a wound in the intestine the needle should be held in the fingers, and not in a holder; we can then appreciate the resistance of the coats more easily, and by this means strike the submucous layers with more certainty.

Accessory Instruments.

Beside the instruments just described, there should always be at hand the following to be used in an emergency:

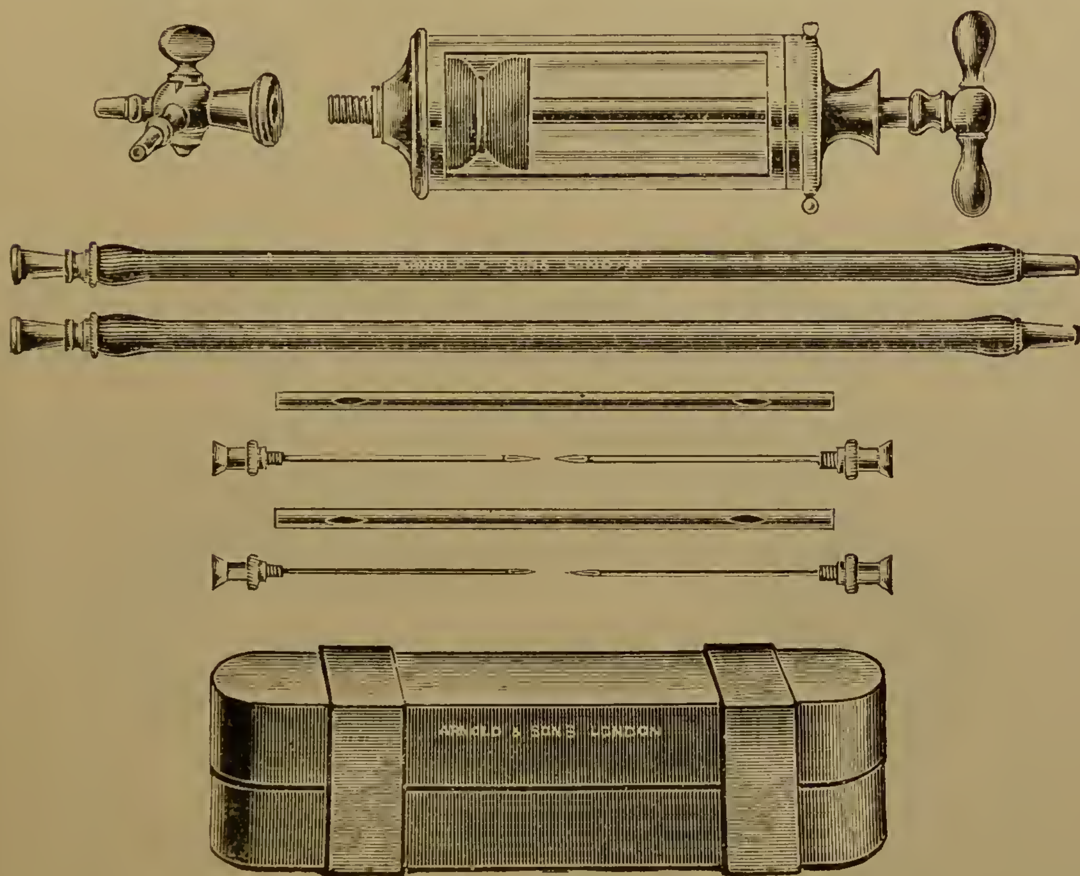


FIG. 45.—Aspirator.

1. **Aspirator.***—This will be found of great use in cases of tubal disease where there is considerable distension of the tube;

* The aspirator is a most excellent instrument when employed as an aspirator; it ceases, however, to be useful when it is used as an exploring instrument, to be blindly thrust into tissues on the chance of striking something. Many a pelvic hæmatocele has been converted into an abscess by the inquisitive explorer.

whether the contents be harmless or not it will often be wise to aspirate the tube not only to facilitate its removal, but also to prevent its contents fouling the peritoneum should we be unfortunate enough to rupture it whilst enucleating it. By walling off the field of operation and aspirating the distended tube, we may rid an operation of its greatest danger. The best

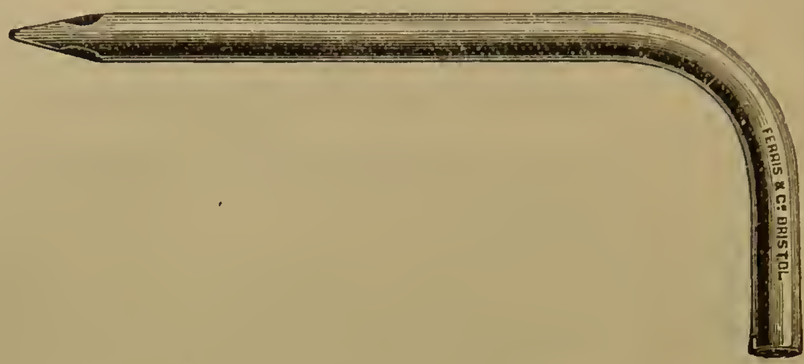


Fig. 46.—Lawson Tait's Cyst Trocar.

aspirator is one in which the sucker consists of a single disc of rubber with a piston so constructed that by turning it the disc becomes expanded (Fig. 45). Such a sucker can be boiled with impunity.

2. **Trocar.**—In dealing with ovarian cysts we may simply

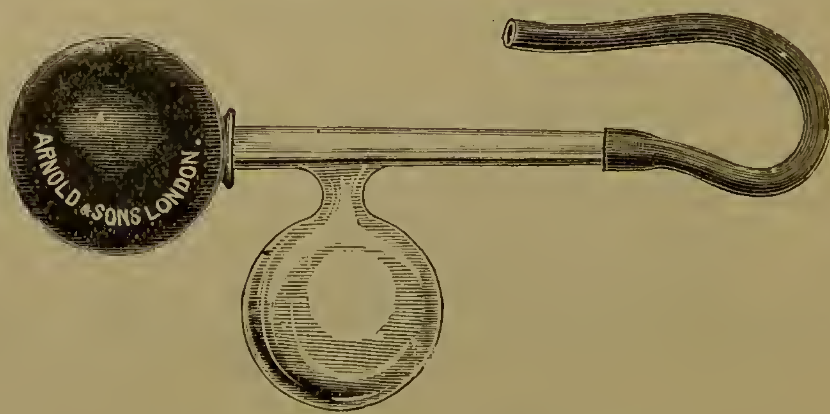


Fig. 47.—Lawson Tait's Suction-Tube.

incise the cyst wall with the scalpel, as we have frequently seen Olshausen of Berlin do, or we may puncture the cyst with Wells' trocar, or with Tait's simple ascites tube (Fig. 46), which we prefer.

Tait was fond of tapping a pyosalpinx with a long curved trocar. After running the pus off into a basin he was wont

to employ the cannula of the trocar as a lever for raising the collapsed tube: this manœuvre is a very useful one at times.

3. **Drainage-tubes.** — If glass drainage-tubes are used, it will be necessary to provide half a dozen of Keith's tubes of various lengths. These are prepared by being boiled in soda-water for half an hour. If a tube has been used at a previous

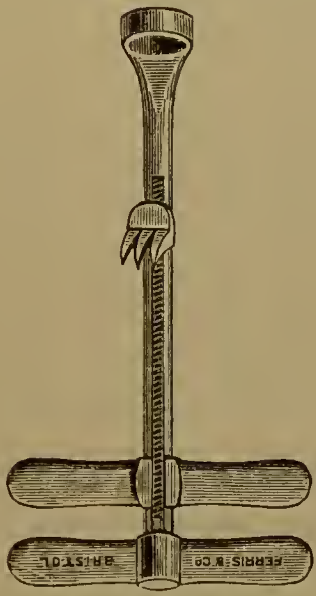


Fig. 48.—Tait's Modification of Kœberlé's Serre-Nœud.

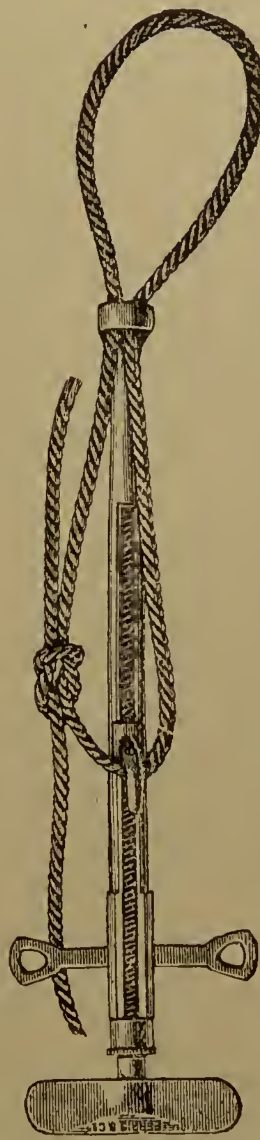


Fig. 49.—Tait's Temporary Rope-Compressor.

operation care must be taken that the holes are not closed with foreign matter; often blood will dry in the ring that is made at the proximal end to prevent the tube slipping into the abdominal cavity. This is best cleansed with a piece of bent wire; mere boiling water will not displace the adherent blood.

In order that the tube may be emptied after the operation is completed a simple glass syringe must be provided. The sucker is best made by rolling sterilized woollen thread round the piston. To the nozzle of the syringe is affixed a piece of rubber-tubing, 6 inches long, in which a small eye is cut about ½ inch from the distal end.

Tait always used a special exhausting apparatus, worked after the manner of a breast-pump (Fig. 47).

4. **Hysterectomy Instruments.**—If the plan of removing the uterus by means of the Serre-Nœud be the one adopted, Kœberlé's or Tait's Serre-Nœud (Fig. 48) should be provided, together with wire and nippers; and Tait's 'Temporary Compressor' (Fig. 49), or Pozzi's elastic tourniquet, together with pedicle skewers, will also be required.

For panhysterectomy it will be well to have a corkscrew or a pair of powerful volsella in which the teeth stand perpendicular to the jaws, in order that we may raise the tumour out of its bed.

A pair of midwifery forceps may be of use in dealing with pelvic fibroids.

5. **Paquelin** cautery, the electric cautery, or the actual cautery may at times be found of great use.

6. **A Catheter** made of glass or metal, and a bladder and a uterine sound, may all be required, especially in defining the limits of the bladder in performing hysterectomy.

7. **Murphy's** buttons should always be at hand.

CHAPTER VII

DISINFECTION OF THE HANDS—RUBBER GLOVES

Disinfection of the Hands.

In the past the fatal* results that followed the performance of sections were due, not to a want of technical skill, but in a large measure to imperfectly-cleansed hands;† in fact, 'it was the willing and tender though unclean hands of the surgeons that carried the poison into the wound' (Keith).

Heat has given us a means which makes the sterilization of our metal instruments absolutely certain, and we have little to learn on this point in the future. Unfortunately, the instrument that is in contact with the wound most frequently—*i.e.*, the surgeon's hand—often defies our methods, and we are yet seeking a means that will satisfy all tests.

* 'As I have said in public more than once, I left Edinburgh with at least one conclusion determined in my mind, that I would never deliberately open the abdomen. The results I had seen in Edinburgh were truly awful—some thirty cases, and not a recovery' (Tait).

† When, however, the operator was a naturally clean man his results were often excellent. Tait says of Syme: 'Personally, Syme was the personification of the best type of gentleman, always perfectly dressed in his old-fashioned way, and as clean as a new pin. From his boots to the top of his head no one ever saw dirt, disorder, or the appearance of hurry. He was always washing his hands. I think I may say he washed them every time he touched a patient. His assistants had to be like him, and his old-fashioned nurses were noted for their tidiness and cleanliness everywhere.' In referring to Syme's results, Tait says: 'The aneurisms, the removal of the whole lower jaw, the fearful œsophagotomies, and, most of all, the thirty-seven consecutive cases of ligature of the femoral artery for popliteal aneurism, not one of which died. Perhaps most noteworthy of all, though least capable of theatrical display, were his numerous perineal sections, and all this without a single antiseptic, but with a detailed care for asepsis which was, perhaps, as great as my own' (Tait, 'The Evolution of the Aseptic Method in Surgery' *Medical Press and Circular*, April 27, 1898).

So far the problem of rendering the hands aseptic has engaged the attention of innumerable observers, and the outcome of their experiences is that the hands cannot be rendered perfectly aseptic by any known means, and consequently many surgeons have thought it necessary to adopt gloves to clothe their hands with, and their results show that surgical technique has been apparently rendered still more perfect since this innovation.

But the wearing of gloves is the exception, and not the rule; consequently it behoves us to inquire into the various plans which have been tried in the endeavour to discover a method by which the hands may be rendered aseptic.

In attacking this problem we must start from the premise that staphylococci are to be found on the surface of the hands of all people; our first task is therefore to rid the superficial surface of the skin of staphylococci and other germs. But, unfortunately, this is not sufficient; for in all the pores and sebaceous follicles, and on all the hair-shafts, we find many species of micro-organisms, so that perfect sterilization of the hands would include destruction of these germs also. It is for this reason that all observers have come to the conclusion that perfect sterilization of the hands must always be absolutely impossible, and for practical purposes, we may add, quite unnecessary; relative sterility is all that is attainable and all that is required for success.

To free the skin and nails from all visible signs of dirt by the aid of soap and water and a nail-brush is the first step in all methods. Before proceeding, however, to soap the hands, it is well to trim the nails short, so that we may the more readily get at the loose cuticle that lies beneath the distal extremity of the nail, for this is undoubtedly the most difficult locality to disinfect—firstly, on account of its guarded position, and secondly, because it is the portion of the finger that is most often contaminated.

After paring the nails we should push the cuticle back from the dorsal surface of the nail, and with a sharp pair of curved scissors (such as are used by the manicurist) trim off any redundant borders. In order to effectually clean under the distal ends of the nail we should seize and depress the pulp of each finger with the thumb, and then cut the cuticle away with a sharp pen-knife; merely to scrape under the nail is not sufficient.

The hands are now immersed in warm water (105° F.) and

allowed to soak for a minute, and then they are vigorously soaped and brushed with a sterile brush. This soaping and brushing should be continued for five minutes, then the distal end of the nails should be cleansed with a metal rod, and the hands should be brushed and soaped for three minutes more, the time being registered by a clock or a sand-glass.

Each one should have a nail-brush for himself, and when once the brushes have been used they should be immersed in some antiseptic fluid.

Some hands are much more difficult to cleanse than others, and it is easier to clean the hands in summer-time than during winter weather; for the cold affects the skin, and causes innumerable small furrows to appear, especially on the index-fingers, and as these are the fingers that are frequently covered with grease in making vaginal examinations, the dirt clings to the bottom and sides of these small furrows in a way that often defies the most vigorous brushing. We have found that rubbing the furrows with a ball of sand-soap, or a piece of cotton-wool soaked in a weak ammonia solution, or in peroxide of hydrogen, will often prove of service. During an operation these furrows become filled with blood, and if sublimate solution is used during the operation for rinsing the hands the blood becomes almost black, and it is most difficult to cleanse the hands afterwards; if iodic hydrarg. is used, the blood is much more easily brushed off afterwards. This preliminary brushing acts by mechanically removing micro-organisms; by dissolving the grease which surrounds the germs and protects them from the action of chemical antiseptics; by tending to break up the 'bunching' arrangements of the germs; and, lastly, by opening the pores of the skin, we open up a channel by which the antiseptic solution may more easily enter to attack those germs that are situated along the hair-shafts.

The soap to be employed is not of much consequence so long as it is of good quality; but soft soap, sterilized oleine soap, Schleich's soap (which consists of marble-dust mixed with green soap), common brown kitchen soap, 'Johnson's Ethereal Antiseptic Soap,' have each and all some slight antiseptic action, and may all be used with advantage. Monkey soap we find very useful.

In order to make the preliminary cleansing more efficacious, it has been augmented by various substances, among which may be

mentioned sand, turpentine, alcohol, ether, and ammonia; but the results show that while these substances help us to rid the skin of grease, they quite fail to sterilize it.

For this reason we must continue the preparation still further in order to disinfect the hands, or, at least, to check and render innocuous those germs that cannot be got rid of by the above mechanical means.

One of the most popular and widely-used methods of achieving this end is to soak the hands in 80 per cent. alcohol, and then to wash them in a solution of sublimate (5 in 1,000).

Experience has shown that this is one of the most satisfactory methods yet suggested, for experiments abundantly prove that 50 per cent. alcohol is a bactericide for the staphylococcus, and when the skin is soaked in spirit a watery solution of sublimate is able to act on it much more rapidly and effectually.

The method which we most frequently employ now is Lockwood's, and we consider it is most satisfactory. It consists in soaking the hands in a solution of biniodide of mercury in methylated spirits (1 in 500). The strength of the spirit solution need not be more than 75 per cent., for it is found that absolute alcohol has little effect on the staphylococcus, while mixtures of pure chemicals in absolute alcohol are inert; the addition, however, of water, and especially warm water, enables the chemicals to act immediately.

The hands should be soaked in the solution of biniodide for two minutes and a half, and the time should be taken by a sand-glass, for it is surprising how long two minutes appear to be when we are bending over a dish. After the hands have been soaked for the required time they are rinsed in a watery solution of biniodide (1 in 1,000). It is most necessary to do this, otherwise the spirit causes a dermatitis that is very painful.*

At Lewisham we use a convenient stand for these solutions, which is so constructed that by pressing a lever with the foot the fluid is allowed to flow into a bowl fixed in a bracket on the stand (Fig. 18).

Satisfactory as the above methods undoubtedly are in practice, they have been objected to, because it has been shown that if the mercury is precipitated by a solution of sulphate of ammonium, cultures may be obtained from scrapings from the skin.

* This dermatitis usually starts in the clefts of the fingers. We have found that, if a little fresh mutton-fat is rubbed in at bedtime, and a pair of cotton gloves are worn, the redness disappears in about thirty-six hours.

In place of the mercuric solution it is now a common practice (and one that appears to be rapidly growing in favour) to soak the hands in a hot saturated solution of permanganate of potash for five minutes, until the skin is stained a very dark colour. If the solution of the permanganate is not strong enough the skin will be insufficiently stained, and the germicidal effects of the solution will be slight.

After the hands have been well soaked they are transferred to a saturated solution of oxalic acid in hot water, or a teaspoonful of the crystals of the acid are placed in the palm of the hand and some hot water poured on them, whereupon they are rubbed well into the skin until the stain of the permanganate has quite disappeared. We have found that by pouring a teaspoonful of peroxide of hydrogen and hot water on to the crystals the bleaching action of the acid is much increased.

After using the oxalic acid the hands may be rinsed in plain water, or in lime-water, when the acid is converted into oxalate of lime, and this does not irritate the skin so much. The irritation in some cases is so great as to produce an eczema between the fingers, while in other cases it makes the skin very rough and harsh.

Some operators, not content with the above process, proceed to soak the hands in a sublimate solution after rinsing off the oxalic acid; and frequently before starting from home to perform a section we wash our hands and disinfect them by this process before packing our instruments, and then at the patient's house we use the sublimate or iodic hydrarg. method.

Krönig and Paul have shown that a 1 per cent. solution of hydrochloric acid with a 1 per cent. solution of permanganate of potash has a more powerful action on anthrax bacilli than a 5 per cent. solution of sublimate; and Senger for the last three years has been able to procure sterility of the hands in 78 per cent. of his cases by using a 2 per cent. warm solution of hydrochloric acid for two minutes, then a 2 to 5 per cent. solution of permanganate of potash for one minute. The action of the acid on the potash causes free chlorine to be developed as well as oxygen. Since the hands are discoloured by this process they may be immediately bleached by sulphurous acid.

Another method which is popular with many operators is thus carried out:

A paste is made by pouring a small quantity of water on to a

mixture of chloride of lime (℥ss.) and washing soda (a cubic inch). This paste is rubbed into the hands as though it were soap, and the process is carried on until all the rough grains of chloride of lime disappear, which will be in from three to five minutes. Nascent chlorine is the active agent in this process, and as it leaves a disagreeable odour on the hands this may be removed by soaking the hands in a sterile solution of a $\frac{1}{5}$ per cent. solution of aqua ammonia.

By any of the above methods we may, as a rule, get the hands into such a sterile condition that we can without fear operate on any section case. It may be that the hands are not completely sterile—in fact, the superficial parts of the hands only are partially sterilized—while the deeper layers of the skin and the sebaceous follicles are most imperfectly sterilized (if at all), but it is abundantly clear that perfect sterility is not necessary and not possible. We can affirm that whilst acting as assistant to the late Mr. Lawson Tait he never used anything but warm water and soap for his hands; and while he was careful not to handle septic material, or to go from a septic case to a section, he certainly never soaked his hands in a germicidal fluid, and yet his success was great.

It must, however, be at once conceded that, after handling septic matter, the hands are utterly unfit for sections without disinfection with chemicals, and even with the means at our disposal it would be well to bear in mind that Zweifel considers that three days should elapse between contact with virulent septic matter and the performance of any operation. The surgeon, in fact, who is about to perform a section should shrink from touching any septic matter, even though it be some days before the time of his operation; for are we yet certain that by freeing the hands of germs we have done all that is necessary to avert that complicated chain of events summed up in the term 'septicæmia'? *

Though the superficial surface of the hands may be sterile at

* 'Thus I operate on a huge perineal abscess, and the smell is enough to empty the house. My fingers are soiled by the horrible pus, and I wash and wash with germicide and perfume, and the smell remains for days. Nobody will persuade me that it is the presence of germs that continues that awful smell. It is the presence of something far more potent than germs; probably a secretion of theirs which soaks deeper and deeper into the skin, far beyond where a germ could go. . . . Some years ago I opened the abdomen of a

the commencement of an operation, it has been frequently demonstrated that as the operation progresses the hands become infected, even though the case be a clean one. The reason for this is that as the operation progresses the perspiration forces the germs out of the pores, and the maceration also liberates them from the deeper layers of the epidermis.

Freeman has shown that if a finger be sterilized and cultures made from the surface epithelium, the result may be negative; but if the same finger be now caused to sweat, that cultures may be easily obtained from the surface epithelium. If now the finger is disinfected and cultures are made, the numbers fall very markedly, his experiments showing that, although sweating the hands doubled the number of micro-organisms at first, a second sweating failed to bring any more to the surface.

The above experiments seem to throw a light on the observed fact that the longer the operation the more likely the infection of the wound; and in the light of Freeman's experiments it will follow that we should cease operating at regular intervals and wash our hands and re-sterilize them. This will take up but a minute or less; even supposing that the micro-organisms are not derived from the deeper layers of the skin, the mere contact of the hands with the instruments and other bodies will gradually lead to their contamination as the operation progresses, and thus we may infect our most carefully-prepared sutures and ligatures.

Bearing in mind Freeman's experiments, and noticing how clean the hands appear after wearing rubber gloves, we would suggest the following method for cleaning the hands after they have come in contact with septic material:

1. Wash the hands in hot water, then scrub with a brush and spiritus saponis Kalinus.

2. Immerse in a hot concentrated solution of permanganate of potash for one minute.

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woman, four days after her labour, for purulent peritonitis, and encountered the fearful putridity. Having strong suspicions of its deadly character, I soaked my hands for hours in various germicidal lotions as hot as I could bear them, till my hands were like those of a washerwoman. On the third and fourth days after I operated on two simple ovarian tumour cases, and the rapidity with which these two women succumbed was altogether shocking, the post-mortem examination showing no other cause than acute septicæmia' (Tait).

3. Wash in a hot, strong solution of oxalic acid, then in lime-water.

4. Draw on a pair of rubber gloves filled with warm water. Wear these for fifteen minutes.

5. Wash the hands in warm water.

6. Rub the hands with a swab that has been dipped into pure peroxide of hydrogen.

7. Immerse the hands in a watery solution of biniodide of mercury for two minutes.

Rubber Gloves.

Some surgeons recognise that the hands cannot be made perfectly sterile by any known method.* There has been a tendency to clothe the hands with gloves made of some material which can be perfectly sterilized; this has led to the introduction of rubber and cotton gloves.

With regard to the latter, Mikulicz suggests that they will offer a satisfactory means of filtering the bacteria, provided they are changed several times during the course of the operation. One may say that these gloves are unsatisfactory, they are clumsy, and if we are to clothe our hands we had better take to the gloves which *à priori* are most likely to fulfil the object that we seek—*i.e.*, the prevention of the escape of bacteria from the skin and pores of the hand into the wound.

Those who have had an extended experience of the use of rubber gloves speak of them with enthusiasm. Those who condemn these gloves seem to have been unfortunate in using gloves that were so thick that they hindered their manipulation and affected their tactile power. The gloves which we use are made by the Kny-Scheerer Company, and when on the hands they fit the fingers so perfectly that it requires but little practice to be able to manipulate with as much ease as with the bare fingers.

The use of gloves appears to be theoretically correct, for if the hands are most carefully prepared so that surface-sterility is obtained, it is found that if rubber gloves are now drawn on and the hands are allowed to perspire, in a short space of time the hands, though encased in the sterile glove, cease to be sterile. As stated above, this is brought about through the per-

* 'Many careful observers claim that it is totally impossible to render any hand perfectly sterile, and in this opinion I heartily concur' (McBurney, 'Annals of Surgery,' vol. ii., 1898, p. 113).

spiration forcing the micro-organisms out of the pores of the skin. Thus the hands become a source of infection to an aseptic wound. This is a fact, not a mere theoretical statement. Yet experience shows us that this must always have occurred, and always will occur, when the bare hand is used; and since thousands of operations are done with the bare hand without any sign of sepsis, it follows that perfect sterility is not always requisite to do operations with absolute success.

The use, therefore, of rubber gloves is optional. We recognise their theoretical value, but since they are expensive and at present difficult to obtain, they will remain a luxury for the majority of surgeons. Nevertheless, there are some cases where their use will be a distinct advantage. Thus, if we determine, say in a case of cancer of the cervix, to cleanse the infected area and to dissect and free the cervix by the vaginal route before proceeding to complete the operation by abdominal section, it will be to the advantage of the surgeon to have his hands covered with gloves during the vaginal portion of the operation.

In a section case, when we have been dealing with a pyosalpinx or any septic material, we hold it would be of advantage in closing the abdominal wound to encase the hands in rubber gloves so as to lessen the risk of infecting the sutures. If in dealing with a pelvic abscess we determined after opening the abdomen to evacuate the abscess by way of the vagina, it will be very convenient for the operator to clothe the hand inserted into the vagina in a rubber glove, or should the bare hand become contaminated, let it be clothed in rubber so as to enable him to complete the abdominal portion of the operation.

We always employ gloves if we have any cuts on our hands.

Perhaps rubber gloves will find their most useful end in clothing the hands of our assistants, inasmuch as they have little to do with fine manipulation during the operation, and we can then at least make sure that they are not contaminating our wounds or ligatures.*

Rubber gloves will also be found of great value in preparing sponges and sutures, for by their use we can handle silk and catgut during any stage of the process of disinfection.

When first obtained from the manufacturer rubber gloves are not sterile, and they must be carefully prepared. They should

* The value of rubber gloves for the military surgeon on active service cannot be too highly appreciated.

be first washed with soap and warm water both inside and outside. A little aqua ammoniæ may be added to the water with advantage. After this they are boiled for fifteen minutes in a 1 per cent. soda solution. After the boiling they may be removed by means of a pair of forceps and laid on a sterile towel, or they may be dropped, as Halsted does, into a large basin of corrosive sublimate solution (1 in 1,000). Before the surgeon places them on his hands he fills the gloves with the sublimate solution, then the nurse stretches the proximal portion of the glove with her index-fingers, and the surgeon pushes his hand into the glove and up into the fingers.

If, however, the hands are quite dry, they may be rubbed with sterilized starch powder, and the gloves can then be drawn on with facility.

It is well to remember that oil will spoil rubber gloves, but the hands may be moistened with glycerine with advantage. Before using the gloves the hands should be prepared as carefully as if the gloves were not to be used;* for during the course of the operation we may perforate the rubber, and if the hands were septic contamination would occur through this newly-formed aperture. In order to guard against such accidents it is well to have a supply of single rubber fingers, so that we can quickly draw one of these accessory fingers over the damaged part. Even if we do not wear rubber gloves, these separate fingers will be found of great benefit if we happen to have an abraded spot whose sterility is doubtful on any of our digits; and in this respect we have used them with success on many occasions.

* 'Clinically, I have found it perfectly satisfactory to simply wash the hands with soap and water and put on the sterile glove' (McBurney).

CHAPTER VIII

THE NOTE-BOOK—THE CONSENT-BOOK

The Note-book.

DURING the time that the patient is being prepared for the operation the surgeon will commence his notes on the case. The young surgeon should consult a copy of Sir Spencer Wells' 'Note-book,' which he will find in that author's work on the 'Diseases of the Ovaries,' and he will do well to read through the same author's 'Cases of Ovariotomy' to guide him in taking the history.

Wells' 'Note-book' was a very elaborate production, and there can be little doubt that, if any operator filled in all the headings found in that book, he would not only train himself to become an accurate observer, but he would also have a record of his cases that would be of infinite value to him, especially if he wished to publish observations later on.*

The note-book which we have been accustomed to use is Tait's; it is, however, not nearly so elaborate as Wells'. It consists of eight sheets (sixteen pages of note-paper).

On page 1 are printed the following words (spaces being left where necessary to fill in the desired information):

Note Book, for cases of abdominal section by............

No. First Seen. Name and Age. Residence. Medical Attendant. Sexual and Menstrual History.

Page 2: State at First Visit. General Appearance and Symptoms. Previous History of Tumour.

Page 3: Present Condition of Tumour and Internal Viscera. Measurements in inches; greatest girth; ensiform cartilage to pubes; position of umbilicus from ensiform cartilage; umbilicus

* 'The success of surgery of this class depends largely upon the matters of detail readily recorded by the experienced, and thus transmissible through literary channels to those who seek for instruction' (Doran).

to right crest of ilium (nearest point); umbilicus to left crest of ilium.

Page 4: Urine. Abstract of Information from Medical Attendant, and History of Previous Treatment.

Page 5: Diagnosis. Treatment.

Page 6: Operation: date; where performed. Anæsthetic: administered by. Assistant. Visitors. Nurse. Particulars of Operation.

Pages 7 to 14: After-treatment: date; hour; temperature; pulse; respiration; notes.

Pages 15, 16: Subsequent history.

Although we have used this book for some years, we consider that it is not nearly large enough to record the after-treatment; and we therefore find that it is more satisfactory to employ school exercise-books with stiff covers. On the outside of the cover is pasted a piece of paper on which is written the name of the patient, the nature of the operation, and the date when performed.

On the inside of this cover is pasted a slip of paper containing a list of the questions to be asked, so that the history will always be taken in a routine fashion. The list of questions to be asked are given below, and in writing the history the headings are inserted in large letters in the margin of the page so as to facilitate reference.

In order that one may have a more vivid remembrance of each case it is well to insert drawings, if abdominal tumours are present. This is made comparatively easy by using a rubber stamp such as Professor Schultze of Jena employs. By using different stamps we can show the outline of the abdomen and pelvis in vertical sagittal section; or, a view of the pelvis looking in from above; or lastly, a large outline diagram of the abdomen by means of which we can represent abdominal tumours as seen from the front.*

In order that the notes taken by the nurse should be of some real use to the surgeon, it is a good plan to have a printed list of the various facts to be noted, and one of these lists can be inserted into the note-book when it is handed over to the nurse after the operation is completed. The list we shall refer to when dealing with the after-treatment.

* These diagrams are those used to such advantage by Schultze in his work on the 'Displacements of the Uterus.'

ROUTINE NOTES AND QUESTIONS FOR SECTION CASES.

Number. Name. Residence. Medical Attendant. Age. Married. Single. Widow. Children. Miscarriages. Menstrual History.

General Appearance. Weight.

General Previous History.

General Present History.

History of Development of Present Condition.

PHYSICAL EXAMINATION.

Respiratory, circulatory, digestive organs.

Examination of abdomen.
- Inspection.
- Palpation.
- Percussion.
- Auscultation.
- Mensuration.
  - Circumference at umbilicus.
  - Circumference half-way below umbilicus.
  - Distance from umbilicus to symphysis pubis.
  - Distance from umbilicus to sternal notch.
  - Distance from umbilicus to right anterior superior spine of ilium and to left spine.

Examination of pelvis.
- Uterus.
- Ovaries.
- Tubes.
- Broad ligaments.
- Vagina.
- Vulva.

Examination of bladder.

Examination of urine.
- Date.
- Time.
- Amount.
- Colour.
- Reaction.
- Specific gravity.
- Deposit.
- Albumen.
- Sugar.
- Urea.
- Microscope.

Abstract of Information from Medical Attendant and History of Previous Treatment.

Diagnosis.
Treatment to be adopted.
Notes on operation.
Result

When the case-book is handed over to the nurse, she will enter her notes under the following headings: Date. Hour. Pulse. Temperature. Respirations. Bowels. Medicine. Nourishment. Remarks.

At Lewisham we have long rubber stamps made with these words affixed, the first stamp containing all the words from date to medicine, and these are stamped on the top of the left-hand page of the exercise-book; the nurse then rules parallel lines with a pencil down the page between the various words, while on the right-hand page the two words 'Nourishment,' 'Remarks,' are stamped. This gives ample room to the nurse to write her remarks, and allows the surgeon to write his notes and directions when visiting the patient.

The Consent-book.

Whilst on this subject of the note-book, we may refer to another book that all abdominal surgeons should have; in this the patient signs her name, giving her consent to the operation. This is very necessary, for it may be the unfortunate lot of a surgeon to be called upon after having performed a section successfully, to answer to the charge that he has done too much or too little, or that he has done something contrary to the wishes of the patient, or her husband.

No man, no matter whether he be famous or obscure, is safe from such a charge; and there are no operations that are so likely to supply a dissatisfied woman with an excuse for an action at law as those which are performed on the ovaries and genital organs.

For this reason every surgeon should have a definite understanding with the patient before he proceeds to operate. If this precaution is not taken, the surgeon may find that the patient has been under some misapprehension* with regard to the nature of the operation, and this may lead her to endeavour to obtain redress. Even though the surgeon may be triumphant, the mere expense of justifying his action may be a costly matter.

No better example could be chosen in this respect than the well-known case of Beatty *v.* Cullingworth.

According to the plaintiff, Cullingworth saw the plaintiff and told her that she was suffering from a prolapsed ovary on her right side, and he said it was necessary to remove it. He told her he thought there was nothing wrong on her left side. She consented to the removal of the right ovary, but repeatedly told him that she would not consent to the removal of the left. When she was under chloroform, after the right ovary was removed, it

* After removing a fibroid by panhysterectomy, one of our patients was much surprised to find that she could not become pregnant.

was found that the left was tending to become like the right, and Cullingworth removed the left one also.

For the defence it was maintained that Cullingworth, believing that the patient had unreservedly trusted herself to his judgment, proceeded with the operation. He found both ovaries diseased, and removed both. When the patient understood what had been done, she denied that she had given her consent to both ovaries being removed, though there was no dispute about the propriety of removing the right ovary.

In a leading article on the case, the *British Medical Journal** said that the sole weakness of Dr. Cullingworth's position was this: That the consent given to him was tacit; implied, not even verbal, much less in writing. Dr. Bidwell (surgeon in charge of the private hospital where the operation was performed) at the trial was unable to say whether it was Miss Beatty or her sister or somebody else who had authorized him to write to Dr. Cullingworth and say that Miss Beatty consented to the operation. Had Dr. Cullingworth got a written consent to the performance of such an operation as he thought right, or even a verbal consent given in unequivocal terms before witnesses, all the subsequent trouble would have been avoided. The moral is: Before doing an operation surgeons should be careful to explain what they propose to do, and get unequivocal consent from the patient, or, if the patient is not in a condition to give consent, from the patient's nearest friends. Such consent should be either in writing, or distinctly expressed before witnesses.

Surgeons should also remember that because an operation is gratuitously performed in a hospital, this is no bar to an action for damages.

Bearing these points in mind, every surgeon should have a book in which the patient signs her consent to the operation to be performed, and the consent should always be obtained from her husband or relatives.

The following is the form which we have used for some years:

I, ..., give my consent to Dr. .... to perform the operation of .... on me; and I also give him full permission to remove any structures that he may consider necessary so as to insure my future health.

Signed........................

Date............ Witness ....

* November 21, 1896.

Another point may be mentioned in regard to a section case. We were once asked to see a patient in consultation, and her medical man then arranged with us to perform a section. After the operation was completed, and the patient was well, the friends entered an action against the family medical attendant for not performing the operation himself. On taking legal advice, the medical man was advised to settle the case, as under the circumstances it would probably have been decided against him.

Therefore if called upon to perform an operation by a medical man, make sure that the friends understand who is to perform the operation.

CHAPTER IX

THE EXAMINATION AND PREPARATION OF THE PATIENT

Except in cases of great emergency, such as the intraperitoneal rupture of an ectopic pregnancy, the sudden twisting of an ovarian pedicle, or the rupture of a uterus, the patient on whom we propose to perform a section should be under observation for several days previous to the operation.

During this period the surgeon will have leisure to carefully observe his patient and to examine her thoroughly, and as a result of his observations he may deem it necessary either to postpone the operation or to abandon it altogether. It behoves every surgeon to make himself acquainted during this period with the condition of the patient's lungs, of her heart, of her kidneys, and to ascertain whether the urine contains sugar, pus, or albumen. 'A careful preliminary study of his cases after this fashion is of paramount importance to the operation, for unless such a routine examination is followed out in every case, now and then a life will be lost from some unsuspected associated disease' (Kelly).

As this part of our subject is the one that the young surgeon will be most likely to neglect, being often eager to operate and 'take his chance,' we shall rapidly sketch* the most important conditions that he should notice, even if by doing so we go beyond the bounds of this essay, though we hold that attention to the extra-pelvic organs is as much a part of 'the preparation' as the cleansing of the skin or the emptying of the bowels; for 'the being competent to operate skilfully is not sufficient for the purposes of surgery, for it is of great importance that the surgeon be qualified to so fit the patient and prepare himself

* Those who require more information on this subject should consult Paget's 'Essays,' and the introductory chapter in Treves' 'Manual of Operative Surgery.'

that no unanticipated complication can happen during, or at any time properly associated with, an operation.'*

The Patient's General Appearance.

Age is in itself no bar; a child of one year and eight months has been successfully operated on for ovarian disease, while women of eighty have not infrequently come through a prolonged section with success. Be careful, however, if your patients are 'fat and bloated, pale, with soft textures, flabby, torpid, wheezy, incapable of exercise, looking older than their years' (Paget).

'The old people that are thin and dry and tough, clear-voiced and bright-eyed, with good stomachs and strong wills, muscular and active, are not bad; they bear all but the largest operations very well. But very bad are they who, looking somewhat like these, are feeble and soft-skinned, with little pulses, bad appetites, and weak digestive powers, so that they cannot, in an emergency, be well nourished' (Paget).

But while we may deem it necessary to be particular in the preparation of the aged, the robust woman may cause us no less anxiety. A strong, muscular washerwoman, whose life has been passed in activity, who has been accustomed to work from morn till night, if brought into a hospital and operated on after a few days' delay, may, indeed, fare badly, for the sudden change in her manner of life has thrown her excretory organs entirely out of gear; a week's preparation would have done much towards adapting her to her altered conditions.

On the other hand, how frequently do we find the wretched creature who has been bed-ridden for months go through the most extensive operations with success; long suffering has adapted her to the bed.†

We have generally found that a country woman needs less preparation than a town woman, and a woman of low rank than one of high social position; and that the country woman bears with fortitude what the dweller in the city bitterly bewails.

Again, the thin woman (and by this we imply the woman who has never been fat, not the obese woman who has grown thin from suffering) is a more favourable subject for an operation

* Bryant, 'Operative Surgery,' vol. i., p. 1.

† 'The risks of shock, of œdema of the lungs, and of septic infection after operation, are all increased in anæmic patients' (Noble).

than the corpulent; in fact, excessive corpulency (except when combined with corresponding muscular development) may almost be a bar to an abdominal section. We had occasion to operate on a young woman who weighed 252 pounds. Being short-handed, we administered the anæsthetic ourselves, and operated at the same time. The operation lasted twenty minutes, and the patient made a good recovery. Twelve months after we were called upon to perform a section on the same woman, and we removed her left tube and ovary; the operation took but ten minutes, and although the anæsthetic was carefully administered by a skilled anæsthetist, the patient expired on the table when about to be removed to her bed.

Among other points to be observed in the patient's general appearance is the presence or absence of any skin disease, such as erythema or pruritus, which would point to kidney trouble or diabetes. Eczema of the skin of the abdominal walls is sufficient reason for postponing an operation. Kelly says: 'In one patient, a woman with thick abdominal walls, upon whom I operated, a superficial eczema was noted at the time, but was not considered dangerous, because of the thorough disinfection. Notwithstanding these precautions, the patient died of a virulent infection with suppuration of the abdominal wound, which extended into the peritoneum.'

Beware of a patient who has any signs of phlebitis.

Examination of the Patient.

After observing the patient's general appearance, examine her from her head downwards.

Head.—Insanity does not contra-indicate a section, though we should remember that patients who have a tendency to be melancholy are apt to develop a more or less profound melancholia, while a chronic alcoholic subject will often develop delirium tremens when forced to stay in bed, the mere confinement being the last factor in determining the acute attack. Treves truly observes that 'a scarcely worse subject for an operation can be found than is provided by the habitual drunkard. The condition contra-indicates any but the most necessary and urgent procedures.'

Post-nasal Adenoids.—We have several times been struck by the excessive difficulty that some patients experience in breathing

when placed in the Trendelenburg position, and after the operation we have discovered that they were the subjects of extensive post-nasal adenoids. The dilated noses, the arched palate, the crossed incisor teeth, the flat chest, the mouth-breathing, and the night-snoring will indicate such subjects.

Chest.—The lungs are to be carefully examined.

Acute phthisis with a high temperature is an absolute contra-indication to the performance of a section, except when the case is one of emergency, as in ruptured tubal pregnancy, when we must lose our patient from hæmorrhage, and we determine to give her the chance of surviving the operation. We should also operate in case of pelvic abscess.

Tubercular peritonitis, when combined with extensive lung trouble, will contra-indicate a section for the abdominal trouble.

We recently removed a portion of the clavicle for tubercular trouble in a child of twelve years. She made good progress for some weeks, but after a time she developed tubercular peritonitis. Her lungs then showed on both sides very extensive tubercular deposits, and we have refused to operate for the abdominal trouble, since we agree with the dictum that an operation for tubercular peritonitis 'is contra-indicated when general acute miliary tuberculosis exists.'*

Chronic phthisis and bronchitis do not contra-indicate a section, though we must expect that the bronchial trouble may sometimes be lighted into an acute condition. We recently operated on a calcified hydatid cyst of the liver, after having first postponed the operation from time to time because the patient had fibroid phthisis and bronchitis. After the operation the patient developed broncho-pneumonia, and narrowly escaped with her life.

It is well to inquire if the patient has been subject to asthma, for if the anæsthetic administered be ether, the patient may have an attack of the most distressing spasm.

A troublesome cough, especially the irritable throat cough that follows an attack of influenza, is a contra-indication to any immediate operation. Nothing can be more distressing to the patient than to be compelled to cough after a section; the excessive pain that such an action causes in the region of the abdominal wound will often make the bravest patient give way to

* Treves, 'Peritonitis,' p. 147. 'Tubercular peritonitis, in so far as the surgeon has to deal with it, is essentially a local disease' (Greig Smith).

tears and lamentations. But not only is the cough distressing to the patient, but by putting a strain on the wound and sutures the foundation of a future incisional hernia may be laid; or the bowels may even protrude, as Greig Smith and others have had the misfortune to record.

Heart.—Bramwell says that persons whose hearts are fatty bear pain badly, and are unfavourable subjects for severe operations. This has certainly been our experience, and we maintain that a patient with a fatty heart is without doubt one of the worst subjects for a section, and were it possible to ascertain this condition with any degree of certainty it would be in our opinion an absolute bar to any extensive operation. We have seen a robust young navvy brought into a hospital with a crushed finger; an anæsthetic was administered, and he expired in five minutes. The post-mortem examination showed that the heart had undergone fatty degeneration, and it was ascertained that he had been an habitual drunkard, although he looked the picture of health.

Valvular lesions need not prevent us from operating in every case. We have recently had occasion to operate on a patient aged seventy-two with loud mitral and aortic murmurs. This patient had been rejected by six other medical men as unfit for any anæsthetic; she, however, came through a very severe ordeal quite safely, and made an excellent recovery. She was a thin, dark-skinned, dried-up-looking female, the best of all subjects, in our opinion, for any surgical procedure.

In all cases when the patient has a heart lesion it is advisable for the surgeon to have the written opinion of a colleague on the case; should any accident occur, he will then have written testimony to bring forth in support of his action. We have only twice had occasion to refuse to perform sections on women on account of valvular lesions. One of these subjects, who had a fibroid jammed in the pelvis, left the hospital, and dropped dead two weeks later; the other, who had malignant disease of the transverse colon, had been rejected by another hospital. Nine months after leaving the hospital she was still alive.

In cases of fibroid of the uterus the heart is often affected, and sudden death may occur after the operation.

Abdomen.—A girl or a woman with symptoms of gastric ulcer is not a fit subject for a section (unless the ulcer itself is the object of the operation), for the straining and vomiting after the

anæsthetic may rupture the wall of the stomach, which is, from the nature of the disease, unfit to receive the nourishment necessary to support such a patient after the operation.

But even evils much less than ulceration of the stomach may be a bar to immediate operation, and we know of no condition which needs to be attended to more zealously before a section than ordinary chronic gastritis. Those who are the subjects of this common disorder become distended after the simplest meal, and often take milk with greatest repugnance. We think that before operating on such cases their stomachs should be irrigated several times, and they should have a course of peptonized foods, with a bismuth mixture, and a pill at bedtime of calomel and iridin.

One simple point may also be attended to: the patient should be taught the knack of belching the wind up from her distended stomach; few patients know how to do this readily, and it is too late to teach them after the operation.

With regard to the alimentary canal, the onset of severe diarrhœa with offensive stools would certainly cause us to postpone a section. We recall the case of a child six months old who had a large tumour in the region of the right kidney and ascending colon upon whom we were about to operate; we were forced to postpone the operation on account of a very severe attack of entero-colitis.

Liver.—Paget warns us to be careful in operating on those who bear that sallow,* dusky complexion with dry skin and dilated small bloodvessels of the face, and sallow, blood-shot conjunctiva, which commonly tells of what is supposed to be an inactive liver.

Advanced cirrhosis is a bar against performing a section except in very urgent conditions.

Kidneys.—Treves says it may be safely said that the results of operations are more powerfully influenced by diseases of the kidneys than by a corresponding disease of any other organ; and he, in common with every careful surgeon, insists that in no case should an operation on an adult be undertaken without a

* If the patient is very jaundiced it is well to give her doses of calcium chloride for some days before the operation, as this serves to prevent hæmorrhage after the operation. It should be given in 30-grain doses by the mouth thrice daily before the operation, and in 60-grain doses by the rectum after the operation (Mayo Robson).

preliminary examination of the urine. He says: 'Before performing an abdominal operation, it should be a matter of routine that the urine be examined daily for not less than a week; almost every surgeon must have met with instances in which the neglect of this precaution has led to calamitous results.'

In examining urine, the date, amount, colour, reaction, specific gravity, sediment, presence of albumen and sugar, should be recorded, as well as the microscopic examination; and in some cases the quantity of urea excreted should be ascertained. Kelly gives some very shrewd observations on this subject, and we here transcribe them in full.

1. No case of advanced nephritis should be subjected to an abdominal operation of greater gravity than a simple tapping of a cyst or an ascites.

2. Women with a marked amount of albumen in the urine should be carefully watched for a time, and if the albumen persist, no serious operation which is not imperative should be performed. Epithelial and blood casts, associated with the albumen, increase the gravity of the outlook.

3. Hyaline and granular casts do not contra-indicate operation unless numerous and persistent. Albumen is found in 23 per cent. of all cases, and casts in 5 per cent.

4. Vascular changes, high-tension pulse, and heart hypertrophy must always be looked for. These alterations become serious when associated with casts and albumen in urine.

5. A marked diminution in the excretion of urea in twenty-four hours associated with a small amount of albumen, or a few casts, must be regarded as of serious import.

6. Pus in the urine, amounting to more than a trace, is of serious significance, and its source must be determined before operation. This will occasionally be found to come from an unsuspected pyelitis or pyelonephritis.

7. Sugar must always be looked for: if scant and transient, it may be disregarded; but if persistent, no major operation should be performed.

We must carefully weigh the result of the examination of the urine. Thus, pus may be present in considerable quantity, but from this we must not jump to the conclusion that the kidney is affected; and pus derived from the bladder would barely be a bar to a section unless the condition giving rise to the pus was an acute trouble.

Albumen may be present in cases of large abdominal tumours, and still not be a contra-indication to an operation—rather the reverse; for being directly dependent upon the presence of the tumour, we have but to remove the latter to find that the urine soon loses the albumen.

Were we called upon to operate in a case where there was an ovarian tumour and a pyonephrosis present at the same time, we should certainly elect to treat the kidney lesion, and later on to attack the ovarian trouble.

Sir Spencer Wells* was accustomed to lay great stress on the following condition of the urine before a section: 'One condition which certainly requires correction before the operation is undertaken is that common one when only a small quantity of highly concentrated urine, depositing mixed urates in abundance, is passed. If ovariotomy be performed on a patient in this condition, a serious amount of kidney congestion, with symptoms almost amounting to uræmic fever, are almost certain to follow the operation.' He was accustomed to prescribe 5 to 10 grains of citrate of lithia in a wineglassful of water three times a day in order to lead to a more abundant secretion of urine free from deposit.

Diabetes.—Diabetes frequently offers a positive bar to any operative procedure. But it has, nevertheless, been shown on more than one occasion that a patient may have a very large quantity of sugar in her urine and yet make a good recovery after section.

Beyea† records a case when the urine was loaded with sugar where a pseudo-mucinous cyst-adenoma was present. After the removal of the tumour, the patient made an excellent recovery, and the sugar entirely disappeared from the urine. Croom‡ has recorded a somewhat similar case.

In spite of these occasional excellent results, we must bear in mind that the tissues of a diabetic patient are very prone to suppurate and slough, and healing of the wound may be indefinitely delayed.

In endeavouring to come to a conclusion as to whether the case is one suitable for operation or not, we should first determine whether the glycosuric condition is the direct result of the

* 'Diseases of the Ovaries,' p. 323.

† *American Journal of Obstetrics*, February, 1900.

‡ *British Gynæcological Journal*, February, 1896.

lesion demanding surgical interference, or whether the sugar has preceded the lesion, and has no connection with it whatever. In cases coming under the first heading the prognosis is distinctly more favourable than it is in the latter case, when the lesion and the glycosuria are independent conditions. If on examining a patient's urine we discover that it contains sugar, we must ask ourselves whether the patient is suffering from (*a*) simple glycosuria, (*b*) the mild stage of diabetes, (*c*) the severe stage of diabetes.

In the first condition, as pointed out by Kleen,* the power of consuming the ingested and digested carbohydrates is but little or momentarily impaired, and the pathological excretion of sugar under ordinary mixed diet only slightly exceeds the traces of sugar found in normal urine. We would have no hesitation in operating on patients in this class.

In the second condition, the excretion of sugar becomes considerable and more persistent, but disappears when the carbohydrates are decreased or withdrawn from the food. These cases, when treated with a strict diabetic diet, may frequently, after a few weeks' preparation, be operated on with safety. Alcoholic habits are always to be strenuously corrected during the time of preparation.

It is when we come to the third condition mentioned above—the severe stage of diabetes—that we must hesitate to carry out any operative procedure. This was the rule in the past. At the present day our aseptic technique has placed the diabetic patient on a much more favourable footing with regard to operations; but it is a wise plan to still regard the diabetic as one who is only to be operated on under very exceptional circumstances.

We shall deal further with this subject in considering diabetic coma during the after-treatment.

Menstruation.—Many surgeons choose a time midway between the periods in order that the vagina may be more easily disinfected. Mr. Tait, however, maintained that it was of little consequence. We have operated on several occasions during the menstrual period, and we are sure that in each case there was more difficulty in controlling the hæmorrhage and more risk of perforating the veins in the broad ligaments.

In cases of menorrhagia or metrorrhagia a patient may im-

* Kleen, 'Diabetes Mellitus and Glycosuria,' 1900.

prove very much by a few weeks' rest in the horizontal position. In preparing such cases a liberal allowance of raw-meat juice, Benger's food, maltine and wine, and the exhibition of a chalybeate tonic, will often work wonders.

Pregnancy.—At one time the pregnant woman was considered outside the range of the surgeon's knife; but owing to the advances in surgical technique and in the success of asepsis, we are now able to operate in many cases where formerly death from sepsis would undoubtedly have followed.

Kelly says: 'Pregnancy does not constitute a contra-indication to the performance of any necessary gynæcological abdominal operation upon the uterus, tubes, or ovaries. The danger to the life of the mother is not materially increased by the fact that she is pregnant, and abortion does not occur as a rule when the operation does not affect the uterus itself.'*

In preparing a pregnant patient for a section it is well not to subject her to extensive disinfection of the vagina, as the excessive irritation of a thorough disinfection of this region may bring on labour.

We have recently had occasion to remove a number of gall-stones from a patient who was seven months pregnant. She made an excellent recovery.

* Gordon's statistics show that ovariotomy tends to cause abortion, about one in five having this result.

CHAPTER X

THE FINAL PREPARATION OF THE PATIENT

When the surgeon has made up his mind to operate, the exact time that a patient should be kept waiting will depend on the nature of her particular disease, or her temperament and her physical condition.

To keep a nervous, excitable woman in bed day after day with the thought ever before her of the operation and its risks is cruel and unnecessary, and will only do harm; while, on the other hand, an elderly woman who comes from the back slums in an emaciated condition will gain pounds in weight when kept in bed for a few weeks on a liberal diet, with an abundance of fresh air and a daily bath.

As a rule, once the operation is decided upon, two to three days will be ample time for the preparation of the patient.

During this period she is to be fed on light, easily-digestible food, avoiding much milk and starchy food and vegetables, such as cabbage and cauliflower, which are prone to create flatulent distension of the stomach and intestines. She may have soup, meat, bone-marrow, beef peptonoids, tomatoes, and fish.

At Lewisham on the day previous to the operation the diet is as follows:

Breakfast.—Tea with milk and sugar; bread-and-butter; lightly-boiled egg.

Dinner.—Meat or fish; bread-and-butter; custard pudding.

Tea.—Tea with sugar and milk; bread-and-butter.

Supper.—Benger's food, 8 ounces.

Day of Operation.—Breakfast-cup of tea or coffee, with milk and sugar; slice of toast and butter; lightly-boiled egg; 11 a.m., mutton broth, 8 ounces; 12.30, Carnrick's peptonoids, 2 ounces. Operation at 2.30.

It is well during these days of enforced rest which precede the

operation for the patient to practise passing her water in the recumbent position, for some women are quite unable to do so at first, and a little practice may save the use of the catheter after the operation. Country women have a great dislike to a bed-pan, and unless the bowels are caused to move by the use of an aperient or by an enema, they are quite unable to have a motion whilst in the recumbent position.

The bowels must always be carefully watched. It is not sufficient for the patient to assure the nurse that the bowels have been moved; the nurse must make it her duty to inspect the motions each day, so as to make sure that the bowel is being sufficiently emptied. Sir Andrew Clark was wont to remark: 'It is quite certain that a daily relief may be an inadequate relief, and that with a regular feculent discharge there may be also a regular feculent accumulation.'

Be careful to inquire, especially in those patients who are advanced in years, how much medicine they are accustomed to take to insure an evacuation, for by giving a large dose of medicine to an enfeebled patient, as is so often done in general hospitals, we may reduce her strength, or even cause her death. Such, indeed, was the experience of Paget, and he therefore remarks: 'In some people a difficult or very copious action of the bowels is an exhausting process, and in them the exhaustion, after many days' inaction, may be a serious matter.'

The most usual aperient to administer to hospital patients a few days before the operation is a mixture of 10 grains of carbonate with a teaspoonful or more of the sulphate of magnesia. Some patients, however, have a great objection to taking 'salts,' and to these we may give a pill composed of aloin, nux vomica, and jalapin; or a teaspoonful or more of liquid extract of cascara sagrada will often act as well as any other purgative.

Should these aperients not have the desired effect, 5 grains of calomel may be administered, to be followed later on by a Seidlitz powder.

On the evening preceding the operation another dose of the saline may be administered, and on the morning of the operation $1\frac{1}{2}$ pints of warm soapy water is to be injected into the bowel. An hour before the patient is placed on the table it is well to pass the rectal tube, and leave it in the bowel for ten minutes, for not infrequently a large quantity of the water of the

enema remains behind, and the patient passes it on the table whilst under the influence of the anæsthetic. By passing the rectal tube the bowel is irritated, and anything remaining in it is expelled; the patient at the same time should be told to try and pass her water, but if she is unable to do so the catheter is passed by the nurse.

At times it may be extremely difficult to empty the colon, on account of the pressure on the bowel from an incarcerated tumour,* or on account of constriction from adhesions or malignant disease. In such cases we frequently find the patient suffering from diarrhœa, and the nurse may be deceived into thinking that the bowels have been well evacuated on account of the frequent motions. In reality the bowel is usually dilated and distended, with accumulated fæces above the constriction. In preparing a case recently for a section the nurse informed us that she had failed to inject more than 6 ounces of fluid into the bowel of a patient who was suffering with constant diarrhœa. On opening the abdomen we found the sigmoid occupied by a cancerous mass, which was adhering to the fundus of the uterus and making a roof to Douglas's pouch, which was distended with a couple of pints of the most foul-smelling, feculent pus.

In some cases when we are dealing with an incarcerated fibroid, we may succeed in passing a firm stomach-tube, or a catheter, up the rectum past the obstruction, and by this means the bowel may be washed out.

There are some operators who are, however, not content with preparing the bowels with purgatives alone, but go still further, and administer intestinal antiseptics.

Tarnier was accustomed to administer cachets of naphthol to the patient previous to performing Cæsarean section: 'Il est bon également de faire prendre à la femme des cachets de naphtol sans préjudice d'un purgatif qui sera donné la veille de l'opération.'

Pozzi says: 'It is only in exceptional cases, especially when there has been evacuations of purulent matter through the rectum, that I administer β-naphthol and salicylate of bismuth to thoroughly disinfect the intestine.' In administering such antiseptics we must take it for granted that small doses of such

* Professor Davis says: 'Over forty bowel movements in two days, with repeated enemas and lavage, were found necessary to empty the bowels in such a case.'

drugs as naphthol, bismuth, or calomel are capable of disinfecting the whole intestinal tract; and there are few who are prepared to make such an admission. It is not reasonable to suppose that the small quantities administered are capable of exerting a lethal influence on the innumerable germs distributed through yards of intestine. While it may be possible to exert an inhibitory action on the micro-organisms in the stomach, we can hardly expect that drugs administered by the mouth can retain their power sufficiently to be of any use when they reach the colon and rectum, and it is upon these portions of the intestinal tract that we should desire the chief action in pelvic surgery.

We may, however, admit that the administration of certain drugs, such as salol, salicylate of bismuth, resorcin, β-naphthol, perchloride of mercury, and benzo-naphthol, is capable of lessening any fermentation that is going on in the bowels, and so tends to guard the patient against the occurrence of excessive flatulence when the subject is suffering from certain forms of digestive trouble, and by lessening the formation of gases in the bowels one may aid in preventing the occurrence of pseudo-ileus and the absorption of the poisonous products from the bowels.

If, indeed, we are able, by intestinal antiseptics, to inhibit the growth of the micro-organisms of the intestinal canal, we shall achieve great results if we administer them in cases where we suspect adhesions, for there can be little doubt that peritonitis is sometimes caused through removing a portion of the muscular walls of the bowel when peeling off an adherent tube or a tumour, and by thus weakening the bowel wall we allow of the escape of the *Bacterium coli commune* into the peritoneal cavity.

Baths.—If the patient be poor her skin will probably be dirty, especially when any furrows or folds occur, and particularly about the umbilical depression. It is well, therefore, whilst the patient is waiting for the operation, to order her a hot bath containing one pound of washing-soda every day, and the nurse should attend and use Castile soap and the flesh-brush on the abdominal walls, and wash out any dirt that has accumulated in the folds and depressions of the umbilicus. Spirits of turpentine may aid the cleansing; it is cheap, and has slight disinfecting properties. If used too strong, however, it will inflame the skin.

Methylated ether may be used in place of turpentine for the skin of delicate women or children.

Preparation of the Field of Operation.

On the day previous to the operation the patient will take a final warm thymol (1 in 1,000) bath, and after this the nurse will begin to prepare the area to be operated on.

This preparation may be divided into three stages: (*a*) The skin is prepared for disinfection; (*b*) the skin is disinfected; (*c*) the skin is kept in an aseptic condition until the operation is begun.

Before going into the details of these various stages, we may briefly refer to some facts in connection with the micro-organisms found on the skin in order to better appreciate the task we have set ourselves.

The skin is everywhere covered with germs, the number of varieties, according to one observer (Mittman) being seventy-eight, of which fifty at least are cocci.

Many of the varieties are non-pathogenic, but among the most constant pathogenic forms are the *Staphylococcus pyogenes aureus* and *albus*, the *Streptococcus pyogenes*, the *Bacillus coli communis*, and the *Staphylococcus epidermidis albus*.

Not only do these germs inhabit the surface of the skin, but they are found on the hairs and in the depths of the follicles and sweat glands.

Welch has pointed out that the *Staphylococcus epidermidis albus*, which may possibly be a variety of the *Staphylococcus pyogenes albus*, though not usually virulent enough to cause suppuration, is frequently found along the hair-shafts, and in this position cannot be attacked by disinfection. After an operation, however, if the conditions are favourable, these germs may become active, and suppuration may be the result. Thus, while it is impossible to thoroughly sterilize the human skin in its depths, yet the superficial parts may be so disinfected that, 'with proper technique, the surgeon has, as a rule, little to fear from the bacteria of the patient's skin as a source of infection of operating wounds' (Welch).

Our task is therefore clearly laid down: we are first to disinfect the skin surface, then to apply an antiseptic so that the surface of the skin is kept aseptic, and at the same time if any germ issues from the pores it is acted upon, and if not killed is rendered inactive.

In order that the superficial parts may be disinfected, the skin must undergo a preliminary treatment. It is not sufficient to simply rely on the application of a germicidal agent; we must first rid the skin surface of the superficial portion of the epithelium, and extract as much fat from the surface and from the sebaceous gland-ducts as possible, in order that we may mechanically rid the skin of as many micro-organisms as possible, and allow our germicidal agents to act with advantage after we have dissolved away the fat, which acts as a protective barrier.

1. **Preparing the Skin for Disinfection.**—The skin of the mons and vulva is first shaved. The shaving, however, of the pubic hair sometimes gives grave offence to a sensitive patient, and it may be advisable to occasionally defer this part of the preparation until the patient is under the anæsthetic, when the hair is shaved or cut with scissors,* and removed by damp cotton mops.

After shaving the skin, the nurse will lather the skin with green soap and warm water, and will rub the lather in with a sterile gauze pad.

An excellent fluid soap may be made as follows, according to the formula of Hanks :

℞	Saponis viridis. opt.	℥iij.
	Alcohol, Glycerinæ, Aquæ	āā℥j.
	Olei bergamot	ʒj.
	Misce.	

After the skin has been well lathered, and the umbilical depression has been minutely examined, the nurse washes the soap off the skin with cotton-wool swabs and sterile water.

It is now necessary for her to leave the patient and to disinfect her own hands, either by soaking them in 1 in 1,000 sublimate solution or biniodide solution, or by treating them with permanganate and oxalic acid.

Returning now to the patient, the nurse proceeds with the second step.

2. **The Disinfection of the Skin.**—This is begun by washing the skin with alcohol or ether, and then for three minutes with

* The small clippers used by barbers, and shaped like a miniature pair of horse-clippers, are excellent for removing the hair from the pubes.

an alcoholic solution of iodic hydrarg. (1 in 500 rectified spirits), a little warm water being added to make the action of the drug more energetic and penetrating. We now reach the third stage.

3. **Preserving the Skin in an Aseptic Condition.**—In order to preserve the skin in an aseptic condition, and at the same time to keep up the disinfecting process, we place a pad of several layers of butter-cloth (which has been allowed to soak in a 1 in 2,000 solution of iodic hydrarg. for some hours) over the cleansed area. In order that the pad will not dry too rapidly, Lockwood suggests that some glycerine should be added to the solution in which the gauze is immersed before it is placed in position on the skin. Covering this gauze is a piece of jaconet, and then the whole is fixed in position with an abdominal binder.

The patient's nightdress is now changed, and she is left for the night.

On the morning of the operation the above process is again repeated, and the patient is placed on the table with the area still covered by the gauze and binder. When the patient is under the influence of the anæsthetic, the binder and the gauze pad are removed by an extra nurse who is not going to take any special part in the operation (such as touching the sponges).

Before the operation commences the operator is handed a kidney tray containing a few cotton-wool swabs and a small basin of iodic hydrarg. in spirit (1 in 500), and he then rubs the line of his proposed incision with one of the swabs dipped in the biniodide solution; or he may, if he prefer, rub the line of incision with pure peroxide of hydrogen.

The process above described is practically that advised by Lockwood, and it is the one that has been used at the Lewisham Hospital for a long period with the most satisfactory results.

The only objection that may be urged against it is that the skin is often made intensely hyperæmic, and consequently in young children and in delicate-skinned women the solution in which the compress is soaked should have very little spirit in it.

In order to contrast the above method with that employed in America, we shall give the most recent details adopted in the Johns Hopkins clinic, as described by Harris.*

The 'ward preparation' is similar to that described above, the skin being soaped and washed with alcohol, ether, and iodic

* *American Journal of Obstetrics*, vol. i., p. 461, 1899.

hydrarg. solution (1 in 1,000). A sterile gauze shield is then laid over the cleansed part, and this is held on with tapes.

In the operating-room, after the patient is anæsthetized, the preparation is continued in two stages. The first is called the 'partial preparation,' the second is the 'final'; between these the 'vaginal cleansing' is done.

1. **Partial preparation** to be done by an assistant whose hands are not necessarily completely sterilized :

(*a*) Remove the ward dressing.
(*b*) Lather with green soap and water, and shave the area thoroughly ; then flush with water.
(*c*) Wash with green soap and water, paying particular attention to the umbilicus and folds of skin in fleshy patients. A wash-ball may be used in this washing.
(*d*) Flush with ether.
(*e*) Wash off with sterilized water.

2. The **vaginal cleansing** is then done :

(*a*) Wash with soap and water, using for this purpose a wash-ball held in a pair of long forceps. First wash the external parts, then take a fresh wash-ball for the internal parts.
(*b*) Flush the parts with 10 per cent. creolin.
(*c*) Flush with mercuric bichloride (1 in 1,000) solution.
(*d*) Flush with sterile water.
(*e*) Catheterize the patient.
(*f*) Flush with mercuric bichloride (1 in 1,000) solution.
(*g*) Flush with sterile water.

3. The **final preparation** of the abdomen is then proceeded with :

(*a*) Wash thoroughly with green soap and water, using a wash-ball.
(*b*) Flush with ether.
(*c*) Flush with alcohol.
(*d*) Flush with mercuric bichloride (1 in 1,000) solution. And in those cases with old scarred skins or slight dermatitis, potassium permanganate and oxalic acid are used.
(*e*) Final flushing with sterile water.

The whole of the above process takes from ten to twelve minutes to execute, and this is a disadvantage when a long operation has to be performed. But the chief objection to this process appears to us to be in merely placing a plain sterile pad on the abdomen during the night preceding the operation, for by the absence of the antiseptic agent a most valuable aid is lost; and as the application of the pad will tend to open the pores of the skin and liberate the germs which invariably come to the surface most readily during the time the skin is perspiring, the sterile pad, unimpregnated with any antiseptic agent, is powerless to act beneficially, and only serves to create a moist, warm nidus for the multiplication of the micro-organisms. The very thorough cleansing on the operating-table rids the skin of many of these germs, but Harris himself shows that growths occur in 60 per cent. of cases from the skin after complete cleansing.

4. **Cleansing the Vagina.**—Whether the section is for tubal disease, ovarian disease, or for hysterectomy, the nurse should always prepare the vagina in case the surgeon should have occasion to open the part during the course of the operation.

On the evening before the operation, after the abdomen is prepared, the vagina should be well irrigated with plain warm water, followed by sublimate solution (1 in 1,000).

On the morning of the operation, after completing the abdominal toilet, the vagina should again be irrigated with plain water and sublimate, and the patient should then be placed in Sims' position and a speculum introduced, by means of which a long strip of gauze soaked in iodic hydrarg. solution (1 in 2,000), or in a 50 per cent. solution of peroxide of hydrogen, may be pushed into the vagina.

Before taking the patient to the operating-chamber, the gauze is removed and the vagina is again irrigated with sublimate.

This preparation of the vagina will be quite sufficient for ordinary purposes; but if the surgeon means to operate partially by the vagina, then the patient may be pulled to the end of the trolley or table, and the vagina may be further cleansed. One of the most convenient ways to do this is to seize two large swabs of cotton-wool with a pair of ovum forceps, and to introduce this into the vagina together with the nozzle of an irrigator con-

nected with a 2 per cent. solution of lysol. On rubbing the vaginal walls with the wool, an excellent lather is formed with the lysol. The vagina may then be finally irrigated with sublimate (1 in 1,000) or biniodide of mercury (1 in 1,000).

If the operator is short-handed, this cleansing of the vagina may be well performed with the hands protected by rubber gloves.

CHAPTER XI

DUTIES OF NURSES BEFORE AND DURING THE OPERATION — DUTY OF ASSISTANTS — DRESS OF THE OPERATOR, ASSISTANTS AND NURSES

Duties of the Nurses Before and During the Operation.

In a large hospital certain nurses are usually detached to do duty in the operating-room for section cases; the same rule should be observed in private hospitals.

The nurse who has charge of the sterilizing-room will also have control of the operating-room. She will be responsible for the aseptic condition of the instruments, dressings, and basins to be used at any operations, and she will prepare the water and attend to the dressing of the operating-table. In short, she is practically the one upon whom will rest, to a large extent, the ultimate result of the operation. Her neglect in sterilizing efficiently any of the dishes, bowls, sponges, or gauze drains may be the weak link in the chain, and so lead to disaster after the most carefully-performed operation.

One does not select this nurse, therefore, without incurring a grave responsibility, and it will be the duty of the conscientious surgeon to devote some of his leisure time to ascertaining if this nurse really understands her business, not in a general way, but in detail; and in order that there may be no doubt on the point, he should insist on her furnishing a report from time to time, giving in the report the details of her work. By forcing a nurse to write such details she will quickly discover her weak points. I think that all such nurses should be given a copy of Schimmelbusch's or Lockwood's book to aid them in their work.

In small hospitals the nurse will usually preside at the operations and be accompanied by another nurse. This is *not* a good plan, for should the case be a septic one, her hands will become

contaminated, and she will go back to her sterilizing-room only to mistrust her hands. It is far better to keep this nurse to such duties that do not compel her to touch any septic matter.

The best arrangement is to have three nurses, and their duties will be as follows :

Nurse 1.—This nurse will take charge of the operation theatre when the patient enters, and the other nurses will take their orders from her. She will disinfect her hands (in a basin set apart for the use of the nurses) just before the operator enters the theatre, and she will receive the sponges from him should he have prepared them himself. She will inquire from him the number he has, and she will count them over to satisfy herself that the number is correct.

She will not need to touch the patient unless she is to assist at the operation, her chief duties being to attend to the sponges, and her position is behind the chief assistant and between him and the anæsthetist. She should have touched no septic case for three days previous to the operation.

Nurse 2.—This nurse stands opposite to Nurse 1 on the other side of the sponge-basin, or in any convenient place in the theatre.

After the ward dressing has been removed from the patient's abdomen by Nurse 3, she will arrange the mackintosh and the carbolized towel, and also the dry towels around the field of operation. She remains in the theatre during the operation, so as to procure any accessory or emergency instruments that may be required; she empties and fills the sponge-basins with hot water for Nurse 1, and she prepares the hot water for irrigation and transfusion; she opens the glass dressing-case or the sterilizing-boxes, and hands the dressings and gauze drains to the operator. Her hands are to be disinfected as carefully as in the case of Nurse 1.

If a small basin be placed on a stand to the left of the assistant the soiled sponges can be placed in it, and Nurse 2 will then empty these into one of the sponge-basins, and when they are washed Nurse 1 places them in a small basin to the right of the assistant, and this basin is filled with biniodide or salt solution.

Nurse 3.—This nurse prepares the skin of the patient in the ward, and passes the catheter * just before accompanying her to

* Greig Smith says: 'I think the advantages of catheterism before operation are somewhat exaggerated. I am convinced that it is unnecessary, and

the anæsthetic room, and remains with her during the preliminary narcosis. On the patient being wheeled into the theatre, this nurse will help the anæsthetist to transfer the patient to the table, and she will then proceed to arrange the hot-water bottles around the patient, and to adjust the blankets and chest coverings. After this she removes the ward dressing, leaving the field of operation ready for Nurse 2, who then proceeds to adjust the mackintosh and sterilized towels, as already described. Nurse 3 may now leave the theatre, as she takes no further part in the operation.

Duty of Assistants Before and During the Operation.

It is, perhaps, superfluous to remark that the assistant's hands are to be as clean as the operator's. In a hospital it will be difficult for the assistant, if he be a house surgeon, to conform to the rule that his hands shall not touch septic matter for three days previous to the operation; and it is for this reason that so much stress has been laid on the fact that the assistant at an operation should always wear rubber gloves. If this fact is of importance in regard to assistants about whom we have some knowledge, how much more should the operator insist on the 'family physician' clothing his hands when that individual, from a mistaken sense of duty, persists in taking part in an operation when performed at the patient's home!

For the young operator nothing can be more advantageous, and nothing can give him more confidence, than having for his assistant a man well acquainted with abdominal work.

When, however, he has performed a few dozen sections he should abandon any plan which makes him rely on another's help and judgment; and we are glad that we long since adopted the plan of simply having a well-trained nurse to assist us at most of our sections. If, however, we anticipate great difficulty, it would be foolish to deprive ourselves of the ready hand of a trained surgeon.

In helping Mr. Tait at an operation one's assistance was

I never have it done. The patient may pass water before operation. If there is some abnormal condition in the bladder which prevents her being able to empty it, I would as soon find this out after operation as before. We can see and feel and accurately locate an enlarged bladder if it is distended; lying flat and empty over a growth we may unwittingly injure it. If the bladder contains so much urine as to be in the way of the operation, it may be emptied by an assistant; this, however, will rarely be necessary.'

generally characterized by what Trousseau would have called 'masterly inactivity.' One was told to hold a pair of forceps, or to steady a large tumour, but beyond this the assistant did nothing. We know of nothing more irritating than to have as an assistant a man who *will* persist in poking his fingers into the wound, or one who keeps up a running fire of comments and recollections of past cases.

The assistant having taken up his position, mops the tissues when blood obscures the field. Even this simple action requires practice, and to become expert we should strike the part with a sharp tap and withdraw the hand in a flash. To press on the bleeding-points whilst you give the sponge half a dozen tremolos of the hand is only to waste time and exasperate the operator.

What we think the art of assisting at an operation consists in would read thus:

1. Do nothing, touch nothing, until requested.
2. Never speak or utter an opinion or comment until asked.
3. Never allow the hand to linger over the operating field so as to obstruct the surgeon's view.
4. Try and follow the surgeon's line of thought, and let your hand be a third hand to him—a help, not an obstacle.*

Should a second assistant be present he should stand behind the operator, on the opposite side of the instrument-table, and he should hand instruments, ligatures, and sutures as they are required. A second assistant is a luxury, and, as it means that your ligatures and sutures are brought into contact with another pair of hands, it means an increased risk, and one that is not necessary.

Dress of the Operator, Assistants, and Nurses.

In all modern hospitals a room is now set apart for the surgeon and his assistants in which they may change their garments; and on the Continent spectators are not admitted into many of the special section theatres unless they have clothed themselves in a washing garment provided by the hospital.

The surgeon's room should be near the theatre, and it should have a bath-room and lavatory adjacent.

The operator and his assistants will do well to divest themselves of their coats in cold weather, and of their trousers and

* 'A dexterous hand without a head to guide it is a blind fool' (Claude Bernard).

shirts in warm weather, and to put on linen pants, which are kept in position by a broad tape which encircles the waist, or by a belt. A silk shirt, or a cotton under-shirt, clothes the upper part of the body, and over all he should wear a garment made like a night-dress (Fig. 50), which opens down the back and has

Fig. 50.—Operation Gown.

short sleeves, which can be tightened to the arm above the elbow, and the waist is caught in by a running tape.

Another convenient method of dressing is to have an overall, the lower portion of which consists of linen pants, and the front and upper part of an apron, which is fastened round the neck by a tape, or they may be made as shown in Fig. 51.

Other operators prefer a white coat and white apron, while others robe themselves in a long rubber apron.

As many of the operating-rooms have tiles, and as these are often wet, it is well for the surgeon, especially in winter weather, to wear white shoes with thick rubber soles. These harmonize with his washing-costume, and they rest the feet if the operation is prolonged.

With regard to the surgeon's personal appearance, there are those who go so far as to say that no surgeon should indulge in long hair or in a beard,* as these harbour germs. To minimize

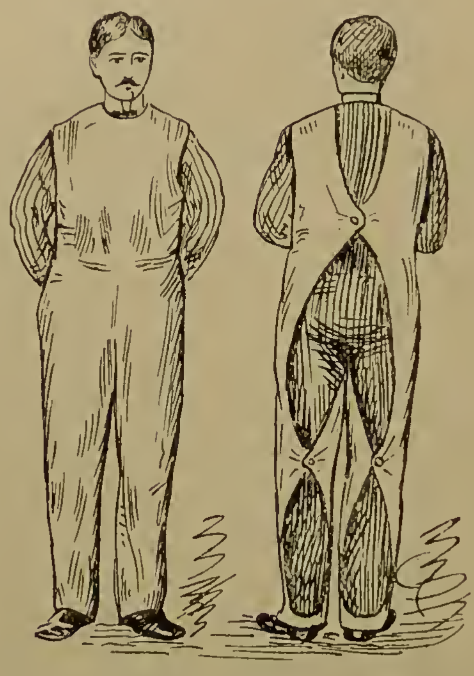

Fig. 51.—Overalls for Assistants at Operations.

these evils, it is held that the operator, assistants, and nurses should all wear caps, or have their hair damp with sublimate.

Not content with these restrictions, others further maintain that the breath of the operator, especially if he has decayed teeth, is a fertile source of infection, and they follow Mikulicz's practice of having a mask, in the form of a chloroform mask, bound about the mouth and nose, and fastened so that breathing will

* As a matter of fact, some of the most successful surgeons that we have seen wear beards, and take no special precautions about them. Among others, we remember that Granville Bantock of London, Martin of Berlin, Kaltenback of Halle, Czerny of Heidelberg, and Billroth of Vienna, all had beards; while beards are almost the rule among French surgeons.

FIG. 52.—Nurse prepared for Operation. (Macnaughton-Jones.)

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be easy. Experiments have shown that during ordinary expiration the mask prevents the germs escaping through the gauze; but should the surgeon cough or sneeze, the gauze does not prevent the passage of the germs.

The nurse should be clothed in a washing-dress with short sleeves (Fig. 52). From her waist-band there should hang two small linen bags or a towel, with which the nurse envelops her hands should she be called upon in an emergency to touch anything that is not sterilized.

CHAPTER XII

THE ANÆSTHETIC

If possible the anæsthetic should be administered in a room adjoining the operating-chamber, for only those who have gone through a severe operation can appreciate the 'sinking feeling that comes over the patient who, after summoning up courage to undergo an ordeal which she may not survive, is asked to walk into an operating-theatre and climb up on the table.' Far better and far kinder is it to place the patient on a trolley in the ward and wheel her into a small room adjoining the theatre, where the anæsthetic can be quietly administered.

Should the surgeon have ascertained that the patient is subject to bronchitis, or that she has a kidney lesion, it will be his duty to inform the anæsthetist of these facts; for, as is well known, ether may cause a serious bronchitis, and it may stop the secretion of urine during the period of anæsthesia and afterwards.

Personally, we like the anæsthetist to commence with chloroform,* and when the patient is well under to change to ether, or a mixture of ether (2 parts) and chloroform (1 part).

An excellent method, and one often practised at the Soho Hospital, is to administer nitrous oxide in the first place, so that the patient becomes rapidly unconscious, and then to continue with chloroform or ether.

'Sometimes a patient refuses one anæsthetic, preferring another; here the administrator clearly cannot shirk responsibility, but must give that agent which he deems best, without regard to the whim of the patient. In the converse case, when death occurs during the administration of an anæsthetic which

* This plan has been objected to, and not without reason, because many deaths under chloroform occur during the first ten minutes.

the patient declines to take until persuaded, cajoled, or cheated into so doing, the anæsthetist would have to show that his selection, although it led to a fatal result, was in point of fact the best he could do for his patient.'*

Whatever anæsthetic is used the administrator should see that he has at hand all those remedies that are usually applied when the patient shows any signs of collapse. In hospital work it will be the duty of the nurse in charge of the operating-chamber to have these things at hand; but in private work the anæsthetist must supply what he may need, for should a fatal result ensue, he will not only have to show that the anæsthetic was administered with due care, but that he applied all the remedies usually employed under such circumstances. To be forced to admit that he had no nitrite of amyl or strychnine, tongue forceps or gag, might bring down on his head the condemnation of a jury.

Whilst ether is considered to be a safer anæsthetic than chloroform, it will often be found that during its administration the abdominal walls do not become relaxed, and the surgeon may be compelled to request the anæsthetist to administer chloroform. Again, if we use the Trendelenburg position and the patient is obese, her face will often become purple, and she will be almost drowned in her own bronchial secretion and saliva. To continue to use ether under such circumstances is a mistake.

With regard to the preliminary injection of morphine and atropine, many observations have been made. McClelland and Harris† carried out a series of observations on 100 patients at one of the Sydney Hospitals, and their conclusions were that the patient became anæsthetized in a very short time, on an average in less than four minutes, and only a small quantity of ether is required to produce and to maintain the anæsthesia. Salivation is the exception, the patient breathes tranquilly, and the tendency to nausea and vomiting after the operation is generally diminished. The best results are obtained when the injection is given twenty to thirty minutes before the operation.

We have observed that when given before chloroform the

* Buxton, 'Anæsthetics,' p. 208.

† 'Observations on Ether Anæsthesia preceded by Administration of Morphia and Atropine Hypodermically' (*Australian Medical Gazette*, July 30, 1899).

patient is anæsthetized more quickly, and the stage of excitement is much shorter, and is frequently absent in women.

We have tried these preliminary injections at Lewisham, and we find the plan satisfactory. We generally order morphine sulphate ($\frac{1}{6}$ grain), atropine sulphate ($\frac{1}{100}$ grain), and strychnine sulphate ($\frac{1}{20}$ grain) half an hour before the time of operation.

CHAPTER XIII

PREPARATION OF THE OPERATING-THEATRE AND OF THE PATIENT ON THE TABLE

Preparation of the Operating-Theatre.

The nurse in charge of the sterilizing-room will superintend the preparing of the theatre. This preparation should not be left until the morning of the operation, for while it is now generally acknowledged 'that the air is an uncongenial resting-place for any bacteria, it is particularly so for the germs of wound infection';* yet we must not altogether disregard the air as a *possible* source of infection, and for this reason any dust that may be in the room should be removed by hosing or mopping with damp cloths on the evening previous to the operation. Therefore the floor and walls should be scrubbed or hosed, and allowed to remain damp, and all places where any dust is likely to rest should be gone over with a damp cloth, so that currents of air cannot set the dust in circulation on the morning of the operation, for it is a well-ascertained fact that neither pathogenic nor non-pathogenic bacteria will pass off a moist surface; and Tyndall showed that when the air in the room is allowed to remain still bacteria gravitate, and the air then becomes pure. We do not, however, agree with those operators, such as Martin of Berlin, who have the walls and the floor of their operating chambers streaming with antiseptic fluids. It is to be remembered that it is easier for a patient to breathe dry air than to breathe air excessively laden with moisture, and the most agreeable temperature to operate in is 72° F. and the air dry.

* Lord Lister says: 'In 1890 I was able to bring forward what was, I believe, absolute demonstration of the harmlessness of the atmospheric dust in surgical operations' (*British Medical Journal*, September 19, 1896).

The Operating-Table.—After wiping this table with a damp cloth, the nurse proceeds to dress it by folding a blanket in such a way that, while it reaches the whole length, it does not, however, project either at the ends or along the sides of the table. Over this blanket a mackintosh sheet is arranged, being tucked under the blanket along the sides of the table. Above the mackintosh a linen sheet is laid, and tucked in so as not to project over the sides. A flat, hard pillow or a sand-bag covered with mackintosh and a slip is placed at the head of the table, and the whole is covered by a thick blanket just wide enough to allow of being tucked well under the patient's legs. A white sheet may go over the blanket. It is most important, no matter what the temperature of the room may be, to have the patient warmly clothed during the operation, and warm bottles should always be placed beneath the upper blanket ten minutes before the patient enters the theatre. Nothing can be more thoughtless than to bring a patient whose teeth are chattering with fright into an operating-room and place her on a cold sheet and cover her with a thin blanket.

Those tables which are so arranged that they can be heated by admitting hot water into their framework are excellent for operations performed in winter weather, especially when the room cannot be heated by a hot-water service.

A small blanket a yard square should be left on the pillow, and this serves to cover the patient's chest. In cold weather we often cover the chest with sheets of cotton-wool, which offer no impediment to the patient's respiration.

Preparation of the Patient on the Operating-Table.

While the surgeon and his assistants are preparing their hands, the patient is being anæsthetized in the room adjoining the theatre, and when ready she is wheeled in on the trolley. If, however, there is no room set apart for the anæsthetic, then the patient must enter the theatre and divest herself of her dressing-gown and slippers.

If she enters on the trolley, she is transferred to the table by the anæsthetist and with the aid of Nurse 3, who has accompanied her from the ward, and who remains by her to remove the protective ward dressing from the field of operation.

When placed on the table, the patient should wear a thick pair of stockings without garters, and should be clothed in a

Fig. 53.—Patient in the Trendelenburg Position.

The four towels are arranged about the field of operation. The arms are enveloped in linen sleeves. The shoulder-pieces prevent the patient slipping towards the anæsthetist.

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thick flannel night-dress, which opens in front and also down the whole length of the back, so that it may be removed with ease at the conclusion of the operation should it become soiled. Nurse 3 now adjusts the hot-water bottles to the patient's feet and to her legs and sides. If the weather is very cold and the table has no special apparatus for warming it, it is advisable to use a large, flat rubber bag under the thighs and legs, or long, thin water-bottles shaped like sand-bags, one being placed between the legs and others on either side. Too much care cannot be exercised in seeing that these bags are covered with three layers of thick blanket, for a rubber water-bag will burn the patient in a most disastrous fashion unless it is effectually covered—in fact, no water-bottle should ever be placed near an unconscious patient unless the cheek of the nurse can stand the application of the bag without inconvenience.

Nurse 3 now arranges the small blanket over the patient's chest, or, what is better, places a large square of cotton-wool on the chest and breast as far down as the ensiform cartilage. If the Trendelenburg position is adopted, and the table has shoulder-rests, then the nurse should see that a thick pad of cotton-wool is inserted between the patient's shoulders and the metal rests (Fig. 53). We have on several occasions had patients complain bitterly of the pains in their shoulders and loss of power in their arms after a prolonged operation when this precaution had not been adopted. We think it cannot be emphasized too strongly that in the Trendelenburg position the weight of the patient's body should be borne by the legs, not by the shoulders.

The blanket that covers the legs of the patient is now turned down so as to expose the mons, and the ward dressing is removed.

Arranging the Field of Operation.—Nurse 2 now comes forward and places a sheet of mackintosh over the pubic blanket, while at the same time she tucks it under the blanket in such a way that the mackintosh covers the upper part of the thigh. Over this mackintosh the sterile towel, which up to this time has been soaking in one of the sponge-basins, is placed; while over the blanket or wool that covers the chest a mackintosh and a dry sterile towel are placed. Stretching between these two towels, and affixed to them by safety-pins, are two dry sterilized

towels, which hide the patient's sides (Fig. 54). When these four towels are fixed in position, the abdomen shows through as a square, in which is situated the prepared field of operation.

As the patient's hands and arms may be in the way, it is well to wrap each one in a towel, or, better still, to enclose the hand and forearm in a long sterilized linen bag; the hands are then drawn up, and the cover is pinned to the pillow.

The operator should not lay his instruments on the towel over the pubes. It is better to have a small stand fitting over the patient's thighs, and holding a small basin, in which are placed the instruments required.

The above description applies to a patient whose skin about the area of operation has been prepared so well in the ward that it will require no further cleansing on the table beyond rubbing it with a little biniodide spirit lotion or a little peroxide of hydrogen.

When, however, the final preparation has to be completed in the operating-theatre, or when the vagina has to be specially prepared or the pubes to be shaved, then it is more convenient to do these final preparations on the trolley on which the patient is wheeled from the anæsthetic room. These final preparations are carried out by the house surgeons or by nurses, but they should not be done by the surgeon or his chief assistant. When the preparations are completed, the patient is transferred to the operating-table, and the blankets and bottles are arranged as described above.

Fig. 54.—Patient on the Table prepared for a Section.

The figure shows the arrangement of the four towels about the field of operation. The arms are enveloped in linen sleeves which are pinned to the pillow by the side of the patient's head.

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CHAPTER XIV

THE POSITION OF TABLES, OPERATOR, ASSISTANTS, AND NURSES DURING THE OPERATION

When the surgeon and his assistant enter the theatre, the chief nurse and her assistant will already have disinfected their hands, and everything will be in readiness. At first small details may be overlooked, and for this reason the chief nurse should keep a list of the things required, so as to make certain that nothing has been forgotten.

Each operator has his own particular fancy as to how the furniture, assistants, and nurses should be disposed of in the theatre. The arrangement that we shall describe is the one followed at the Lewisham Hospital, and the theatre will therefore present the following appearance during the course of a section.

1. The **Anæsthetist** (A) sits on a metal stool, or stands at the head of the table (T) and faces the light (W). By his right side is a small glass-top table (AT, Fig. 55), on which the following articles are placed:

(*a*) Clover's inhaler for ether, with a measure-glass.

(*b*) Bottle of ether (stock).

(*c*) Chloroform mask covered with a piece of lint.

(*d*) Bottle of chloroform (stock); graduated bottle.*

(*e*) Gag; tongue forceps.

(*f*) Hypodermic syringe charged with liq. strychninæ (5 minims).

(*g*) Tablets of morphine ($\frac{1}{6}$ grain) and atropine ($\frac{1}{100}$ grain).

(*h*) Capsules of nitrite of amyl; bottle of adrenalin chloride solution.

(*i*) Enamel basin and towel in case the patient should vomit.

* An oxygen apparatus and a Faradic battery should be kept in the room adjoining the operating-theatre.

2. The **Operator** (S) stands on the right of the patient and to the right of the table.

Should the Trendelenburg position be the one adopted, the patient will be placed with her head at the foot of the table, so that the elevated abdomen will face the full light of the end window. The surgeon will stand on the right of the table, as

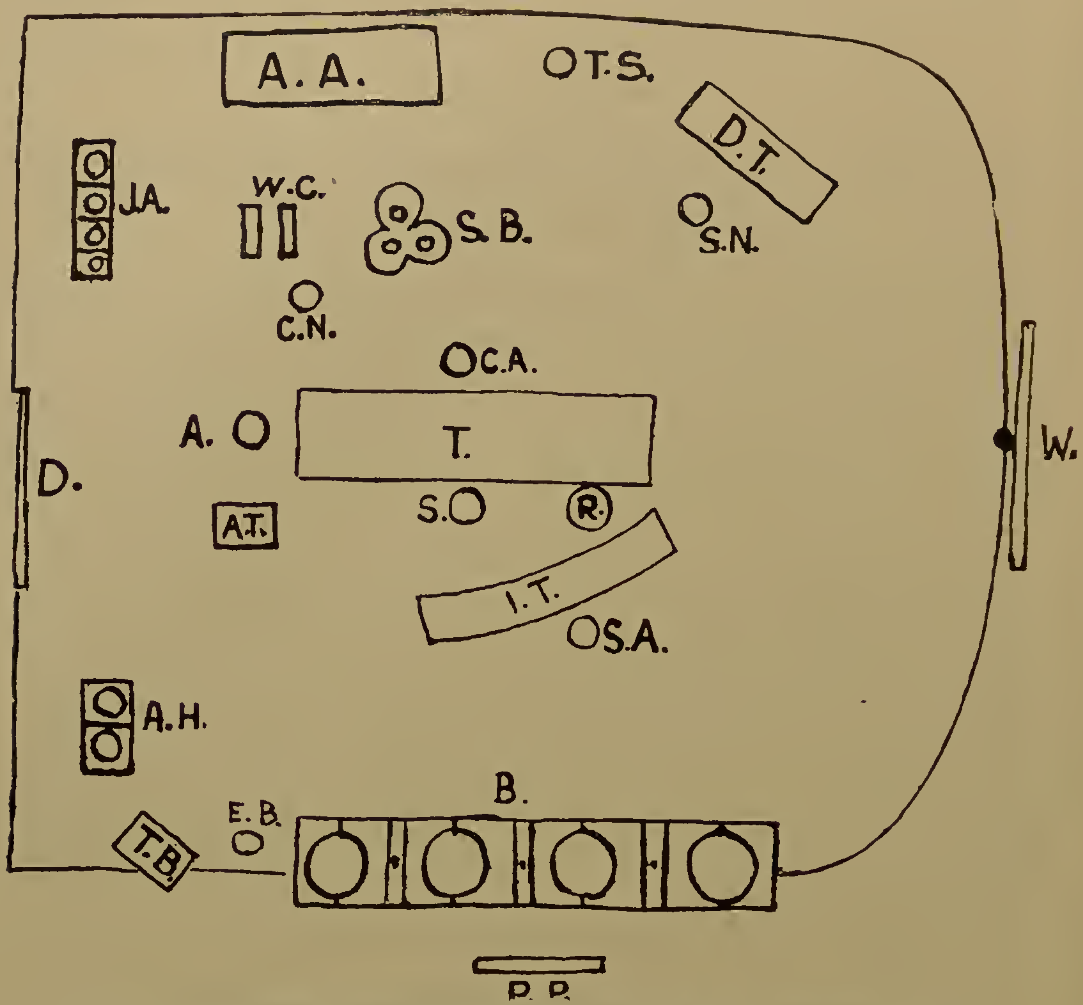

FIG. 55.—Diagram of Operation-Theatre, showing the Arrangement of the Tables at the Time of the Operation.

before, but he will now be on the *left* side of the patient. He has immediately behind him a long curved table (IT) with a glass top, on which stands:

(*a*) Three glass dishes for instruments.

(*b*) Two glass bowls for sutures and ligatures.

(*c*) One enamel plate for needles.

(*d*) One glass bowl filled with sterile warm water or iodic hydrarg. solution (1 in 3,000), for rinsing the hands during the course of the operation.

Some operators place all their instruments in one large dish. It will be found, however, more convenient and less confusing to have the instruments classified and arranged in three oblong dishes, from which they may be taken by the surgeon or by a second assistant, who stands behind the operator on the other side of the instrument table (SA).

3. Beneath the operating-table, and on the side on which the operator stands, a receptacle (R) is placed to catch fluids, which are conveyed to it by a rubber pipe attached to the trocar used in tapping cysts, or the fluid used in irrigating the peritoneal cavity may be caught by a Kelly rubber drainage-pad placed beneath the patient and communicating with the receptacle below.

4. Opposite to the operator stands the **Chief Assistant** (CA).

5. Behind the assistant and between him and the anæsthetist stands the **Chief Nurse** (CN), who manages the sponges, which are placed in three basins (SB) immediately behind the assistant. Some surgeons, however, prefer that the assistant alone should manage the sponges.

When the surgeon begins the operation at least two people in the room should know with how many sponges the operation was started.

On either side of the assistant a small basin may stand, the one to his left receiving the soiled sponges, the one to his right the washed sponges from the chief nurse.

Beneath the sponge-table is a bucket into which the sponge-water is emptied from time to time, while two enamelled water-cans (WC) are placed close by, the one containing boiling water, the other cold sterilized water for filling the sponge-basins.

6. Near the sponge basins another table (DT) is placed, upon which should stand the metal boxes containing the sterilized dressings, binders, towels, and gauze drains. By this table Nurse 2 (SN) takes her stand so that she may hand out of these boxes anything that may be required. On no excuse are others to open these boxes and remove the contents unless their hands are disinfected. Under this table a glass dressing-box (Fig. 56) may be fixed, which will contain the dressing to be used. This will generally consist of a few layers of gauze, some squares of cotton-wool, and a binder ; and the table should have a shelf on which will stand a large glass jar containing sterilized swabs of

cotton-wool, or the fan-shaped pieces of gauze used as dabs to clean the abdominal walls and mop the blood before the peritoneum is reached. By this jar is placed a glass kidney-tray or an enamel dish, with a pair of forceps, so that the swabs may be lifted out of the glass jar when required. A bottle with a perforated metal top containing iodoform, and another containing boracic acid, should also be placed on the shelf in case the operator wishes to dust these powders on the skin after the

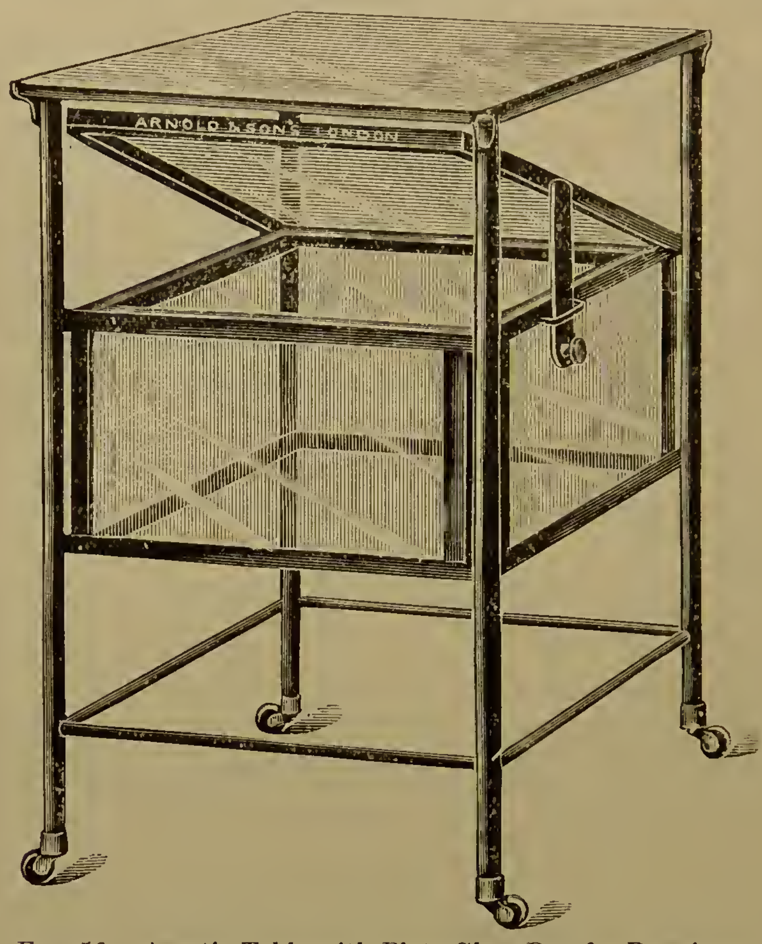

Fig. 56.—Aseptic Table with Plate-Glass Box for Dressings.

operation. Here also a small jar full of safety-pins may be placed ; these are used for holding the binder in position, and we may add a roll of Mead's plaster 2½ inches wide.

7. On the other side of the sponge-table is placed a table, AA (Fig. 57), on which will stand the following accessories, which may be wanted at any moment during the operation :

(*a*) A glass douche reservoir capable of holding 2 quarts, to which is attached 6 feet of rubber-tubing, to the end of which is affixed a cannula and trocar. The apparatus is used

for transfusing salt solution under the mammæ, and it may be attached to a stand which is wheeled to the side of the patient.

(*b*) A bottle containing salt solution of the strength of 228 grains sodium chloride to 2 ounces of water; 2 ounces of this solution in 4 pints of warm water will give us the proper strength for the transfusion fluid.

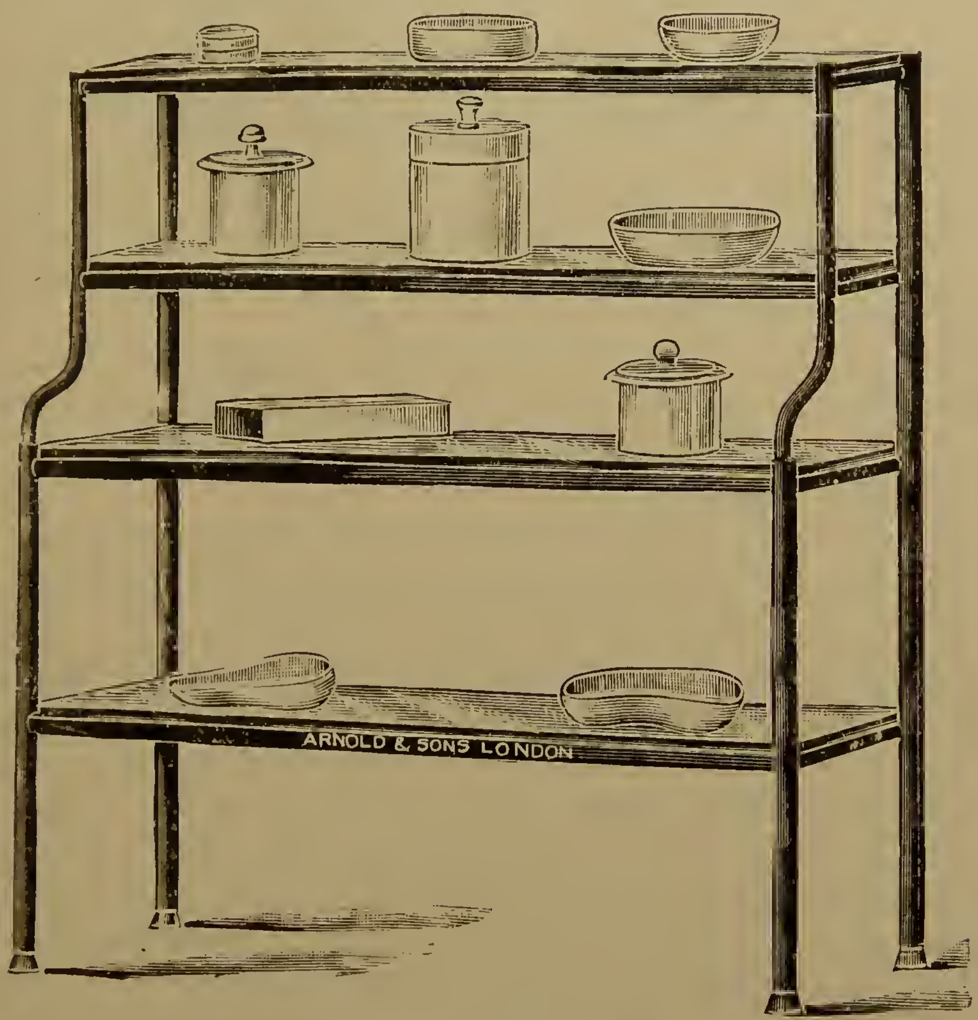

Fig. 57.—Wall Stand.

A more accurate imitation of blood serum is made by dissolving the following powder:

Sodii chloridi ...	...	...	642 grains.
Sodii sulphatis ...	...	...	$3\frac{3}{4}$,,
Sodii carbonatis	...	...	$1\frac{5}{6}$,,
Sodii phosphatis	...	...	$1\frac{1}{4}$,,
Magnesiæ phosphatis	...	...	$1\frac{1}{24}$,,

Sig.—Make into a powder, and dissolve in 4 pints and 3 ounces of water.

(*c*) A glass funnel, to which is attached 4 feet of stout rubber-tubing, fitted with an ordinary rectal pipe, is to be kept in readiness in case we wish to inject any fluid into the bowel, such as saline solution or brandy, and a flask of the latter is always at hand.

(*d*) A glass or enamel jug may be used for pouring saline solution into the peritoneal cavity to irrigate, or merely to be left there in place of subcutaneous transfusion.

(*e*) A small bottle containing aristol or sterilized powdered persulphate of iron, a pinch of which will frequently stop oozing that cannot be conveniently controlled by a ligature.

(*f*) A bottle of peroxide of hydrogen is useful for the peritoneal toilet in septic cases, and for the skin surface after the operation.

(*g*) Kidney-shaped and round dishes are useful for receiving the parts removed during the operation.

(*h*) A sand-bag covered with mackintosh may be required.

(*i*) Beneath this table will be placed the small portable electric battery with lamp attached, in case artificial light should be required.

8. Close to the table containing the above accessories is placed a stand (JA), or a shelf, for three jars, which will contain 2 gallons of antiseptic fluids (stock). The first jar should hold biniodide solution (1 in 500), the next holds sublimate solution (1 in 500), and the third contains carbolic acid solution (1 in 10); these solutions thus allow of the addition of warm water to reduce them to the strength of the solutions usually employed.

9. Behind the surgeon are placed the wash-hand basins (B) with the sterilized nail-brushes and the soap, and on a stand at the end of the hopper a metal box (TB) is placed to contain sterilized towels, which on being used are thrown into an enamel bucket (EB) situated conveniently near the hopper

10. On a small glass shelf (PP) above the basins will stand jars, one containing a concentrated solution of permanganate of potash, and the other crystals of oxalic acid, for disinfecting the hands. Some lime-water may also be at hand to precipitate the oxalic acid after the permanganate has been completely removed from the skin.

11. At Lewisham, where we do not employ the potash method for disinfecting the hands, there is placed near the wash-basins a jar (AH) containing a solution of iodic hydrarg. in methylated spirits (1 in 500); the jar is fitted with a rubber pipe, which can

be opened by placing the foot on a lever, and the spirit then escapes into a glass basin, in which the hands are soaked. By its side is placed a watery solution of biniodide (1 in 1,000) to wash the spirit off the hands.

Kelly's rubber drainage-pad may be in readiness in case we may require to irrigate the peritoneal cavity.

12. An enamelled receptacle (TS) is placed in the room anywhere out of the way, and into this soiled swabs, etc., may be thrown.

13. A clock should always be in the theatre to show the operator how much time he is spending over the various steps of the operation.

CHAPTER XV

THE DRESSINGS AND BINDER

The Dressings.

The operation being concluded, the dressings are applied. It would be a considerable labour to make a list of all the materials that have been and are being employed to cover the abdominal wound.*

The following methods are very widely adopted.

Mr. Tait was accustomed to place boracic acid on the wound and heap it up until he had a layer $\frac{1}{4}$ inch deep, his reason being to keep the wound as dry as possible, and he considered that boracic acid did this better than anything he had tried. Over the powder he placed a few pads of plain 'gamgee tissue,' and over these applied a binder.

The application of boracic powder, or iodoform, iodoformogen, dermatol, iodol, aristol, salol, soziodol, and sulphaminol, is a very general practice. Of these powders, probably iodoform is the one most universally employed. The true value of this substance when applied to the skin is not yet definitely ascertained. In the presence of pus Behring showed that iodoform was decomposed and iodine set free and the ptomaines destroyed, but it does not appear that iodine is liberated when iodoform is dusted on the skin beneath antiseptic dressings. One fact is undoubted: iodoform possesses little germicidal power in itself, and therefore it should always be sterilized by exposure to heat before it is applied to the skin.

Lockwood sums up his reasons for using iodoform in the following words:

* Wells used thymol cotton, Keith used gauze wrung out of glycerole of carbolic acid, Thornton used Lister's gauze and mackintosh, while Bantock uses plain dry absorbent gauze.

'Thus, although the disinfecting properties of iodoform are doubtful, yet its antiseptic render it a valuable adjunct; therefore, as no bacteria will grow in the presence of dry iodoform, I use it for dusting upon the skin all around, but not within the wounds. It seems reasonable to suppose that if the skin had escaped disinfection, the growth of bacteria from its sweat glands, sebaceous glands, or hair follicles would be arrested by the iodoform, and not grow as far as the wound; next, the layer of iodoform seems to me to have a great value in preventing bacteria passing from the exterior of the dressings along the skin into the wound.'

In addition to these reasons, iodoform has soothing and anodyne properties, and it has the power of preventing blistering of the skin beneath dressings.

Greig Smith used to hold that it mattered very little what the dressing was so long as it was unirritating and absorbent, and he usually employed a few folds of boracic lint.

Kelly uses a square of sterilized gauze six or eight layers in thickness, and then covers the whole with layers of sterilized cotton.

This plain gauze is an excellent covering for the wound and skin, and fulfils the chief indications of a good dressing—*i.e.*, it absorbs all secretions from the wound in a thorough manner, and it is in itself free from pathogenic germs.

There are some, however, who consider that a dressing should be impregnated with antiseptics, so that the secretions from the wound will not undergo decomposition. With this aim in view they employ iodoform and iodoform gauze to prevent the multiplication of those germs which emerge from the skin follicles; above this is placed a layer of carbolic gauze, wrung out of biniodide solution, so that it will disinfect any fluids that may escape from the wound and protect the skin from the next layer of tissue, composed of strong alembroth wool, which soaks up any fluids from the wound and renders them inert. Not content with these coverings, they then add a few layers more of gauze, and finally cover the whole with waterproof jaconet.

We have tried many plans for dressing the abdominal wound, and the one that we prefer is this: Having closed the wound, we wash the skin free from all signs of blood, and then pour over the wound a few ounces of pure peroxide of hydrogen. The skin is well cleansed again by rubbing the peroxide into all parts, and every particle of blood is removed from the folds and crevices by the

silk-gut sutures. The skin is then dried and a piece of plain sterilized gauze is placed over the sutures, so as to project three or four inches beyond the wound on all sides.* Half an ounce of peroxide of hydrogen is poured on this, and then the whole is covered with several layers of plain sterilized gauze, over which some squares of cotton-wool, encased in a layer of gauze, are placed.

From the excellent results we have recently had in operating on children for hernia and in adults after performing Alexander's operation, we are inclined to recommend the following plan also, which we have recently tried, for dressing the abdominal wound: The skin is washed free from blood with biniodide lotion (1 in 1,000), and then washed with peroxide of hydrogen and dried. Then a strip of Credé's silver-gauze is laid over the sutures, and this is fixed in position by two or three broad strips of plaster. We think this dressing has one advantage: that no matter how the patient may move the wound never becomes exposed; whereas with the binder, unless perineal bands are used, the lower part of the wound is easily exposed, or, if not exposed, rendered easily accessible to the air when the patient is lying in bed with the legs drawn up.

Should a glass drainage-tube be employed, a hole is made in the first layers of gauze, so as to slip the projecting end of the tube through. In order that the escaping fluid may not soil the dressings, it is well to slip the tube through a small aperture in a square of jaconet; this grasps the tube all round if the aperture has not been made too large, and a piece of alembroth wool, or a sponge, being then placed over the end of the tube, the jaconet is folded over it. When the sponge is saturated it is changed for another, and the tube is exhausted with the sucker. The dressing need not be disturbed, one tail only of the binder being loosened to get at the tube.

If we employ a gauze drain, then it is often impossible to prevent the dressing from being soiled. Some operators wrap a piece of rubber tissue round that part of the gauze that traverses the abdominal wound, while the portion that projects beyond the abdominal walls is pulled out into a funnel so as to surround the drain on all sides.

* Before placing the gauze in position the edges may be moistened with collodion, which causes the gauze to adhere to the skin; the movements of the patient cannot then displace it.

The rubber tissue prevents the gauze sticking to the walls of the wound, and at the same time prevents the drain from soiling the dressing next the wound to any great extent.

The Binder.

To keep the dressings in place we may fix them with strips of adhesive plaster, or by means of a double spica bandage or a binder. The latter is the most usual and most convenient method.

A good binder is to be made of a material that will tear easily, so that we may alter the length of the tails if required ; but the material at the same time should be inelastic, so that when the tail is pulled upon it can be stretched tightly without its breadth diminishing. Thus, flannelette is often used for economy, but it makes a wretched binder, for when the tails are pulled upon, each one diminishes to a narrow band, while the portion of the binder that covers the lumbar region is thrown into innumerable creases. Canton flannel is much thicker and firmer, and makes a good binder. The material we prefer is known as 'twilled sheeting.' It is very firm, and it tears easily when we wish to lengthen the tails, and these, when pulled in, do not pucker up and become narrow. It is much more agreeable in warm weather for a sensitive skin than flannel, which often irritates the back and sides, and causes the patient to perspire, unless Thornton's plan is adopted of lining the flannel with soft calico and sewing this over all the edges of the binder.

To make a binder a piece of twilled sheeting is taken 60 inches in length and 16 inches wide. Four tails, each 18 inches in length and 4 inches in width, are torn from each end, and, if necessary, these tails may be further torn when adjusting the binder.

It should be the duty of the nurse in charge of the operating theatre to measure the patient so that the binder will be the correct length. The measure should be the circumference of the body at the level of the umbilicus and half as much again ; thus, if the circumference is 40 inches, the binder should be 60 inches in length. Should the patient have a large abdominal tumour, the circumference at the level of the great trochanters may be taken.

The Scultetus bandage is one often used, for it has the advantage of perineal straps. It is made by placing four strips

of flannel, each 60 inches long and 4 inches wide, parallel to each other; these are sewn to two other strips 4 inches wide and 30 inches long, placed at right angles to them, so as to make a kind of T-bandage having two perineal bands, which serve both to keep a pad on the vulva, should this be required, and also to prevent the binder from slipping up over the trochanters when the patient draws her legs up in bed.

When the dressings have been placed in position, the rubber pad is removed from under the patient, and the back and sides are dried. If the nightdress is soiled it is removed by unbuttoning it down the back; nothing can be more awkward than a gown that opens in front only.

The binder is rolled up from both ends until the two rolls meet in the centre, and the surgeon or the assistant then lifts the patient up by raising the pelvis, and the nurse slips one of the rolls under the patient's loins and buttocks. If, however, the patient is very obese, the easiest way of slipping the binder under her is for the surgeon to grasp her by the side of the pelvis and ribs and roll her towards him, while the nurse pushes one of the rolls of the binder under her as far as it will go; she is then rolled on to the opposite side, and the binder is grasped by the surgeon and pulled up. The binder must be pulled down so that the lower border will be a few inches below the great trochanter on either side. In order to secure it the assistant takes up the lowest tail of his side, while the surgeon takes up the corresponding tail on his, and both draw in opposite directions. The surgeon then stretches his end over to the assistant, who takes the borders between his two hands, after giving his own end to the surgeon. Each tail is drawn as tightly as possible in opposite directions, and are secured by safety-pins (placed at right angles to the long diameter of the tail), and in such a way that the portion held by the surgeon is uppermost, and completely hides from view that portion of the tail held by the assistant.

The other ends are secured in the same way, but care should be taken not to draw the upper tails, that lie immediately across the epigastrium, too tightly, or the patient will be most uncomfortable, and will complain bitterly of the oppression when she becomes conscious.

Having secured the abdominal portion, the perineal bands are now secured to the lowermost transverse bands.

One small matter should be attended to. In introducing the pins the bands may be so tense that we do not notice the fact that the pin, on being inserted, has caught up the skin of the patient. We have known this happen to others as well as to ourselves.

If we are using a glass drainage-tube the greatest care must be taken not to draw the binder too tightly over it, or it will be forced down and may injure the bowel, or cause excessive vomiting and pain. The best plan is to secure the second band from the bottom over the tube in such a way that, while it does not force the tube down, it is at the same time sufficiently tight to prevent the tube from being forced out and displaced to the side when the patient is vomiting.

Martin, of Berlin, used always a bandage made of gauze, which was squeezed out of carbolic solution and allowed to dry. It was then rolled round the patient in the form of a double spica, this manœuvre being rendered easy by the employment of the Frau Horn table, which has a small leaf in it that can be opened beneath the patient's loins.

There are some operators who have given up the use of the binder in favour of adhesive plaster. Greig Smith says: 'After removal of a large tumour, I think the plan of covering the whole abdomen with long, broad layers of strapping should be adopted. The sudden decrease of abdominal tension that follows removal of an abdominal tumour no doubt favours gaseous distension of the bowels, and strapping is undoubtedly a better means of preventing this than a tight binder. The straps of plaster act as a firm, unyielding splint, keeping the parts immovable, and permitting the patient whatever liberty of movement she may desire.'

Should strapping be employed, it should not be kept on for more than four days, or the skin, particularly in stout patients, will become very irritated and sore.

CHAPTER XVI

THE STERILIZING ROOM AND THE PREPARATION OF INSTRUMENTS AND LIGATURES AT THE SURGEON'S RESIDENCE

Introduction.

We have in the foregoing pages drawn a picture, however imperfect, of the means by which surgeons in the present day endeavour to attain to ideal surgical cleanliness.

We have ourselves followed out in our own practice these details in order to become practically acquainted with them, so that we might judge for ourselves what was necessary and what superfluous, and we have no hesitation in saying to the young surgeon that, if he will follow the details we have given in the foregoing pages, he will be in a fair way to attain to a high degree of surgical cleanliness, which is the true foundation-stone of surgical success.

But we have not been content with one side of the picture; we have turned to the other side, and we have found that while many of the details that we have given are very admirable theoretically, they are not, however, *absolutely* necessary for success.

We were led to this conclusion by watching the work of the late Lawson Tait during the months when we had the privilege of acting as one of his assistants.

We had but recently come from hospitals where strict antiseptic precautions were the rule, and we had every reason to respect the antiseptic technique. When, therefore, we came face to face with a man who never used anything stronger than soap and water for his hands and the patient's skin: who abhorred the name of carbolic and iodoform; who had for years seen in hot water and washing-soda an ideal means of preparing his instruments; and when we were able to watch his perfect

results day after day and month after month, we were slowly led to admit that there *were* two sides to the modern picture of clean surgery. In short, the lesson that we learnt was, that it was possible for one to achieve the greatest success in abdominal surgery by the employment of hot water, soap, and washing-soda. Ten years of practical work has, however, taught us another lesson, that while soap, soda, and hot water are sufficient for this success, the addition of sublimate or biniodide of mercury to this trinity makes our achievements still easier.

Anyone who has the opportunity of following out the details that we have given in the first part of this essay should do so, in order that the training may have its influence; then, if the simple technique be desired, this will be rendered possible by knowing all the points at which precautions must be taken to insure success.

We think it would be, for many surgeons, only a ready means for courting disaster to rush at the outset to Tait's simple technique, for to do so would tend to engender a reckless disregard for the germ theory, which, unsatisfying as it may be to many, should be the key-note to our practice for the present.

In the hospital where we have been accustomed to operate for some years, the surgeons have always provided their own instruments, ligatures, and sponges, so that we have had from the first to prepare these things at our own homes and transport them to the operation. We do not regret this arrangement, as it forced us to consider and study the details of the preparation of instruments and ligatures, and it now enables us to show how any surgeon may easily prepare all the things requisite for a section at his home, and transport them without danger to his patient's house. In fact, this is the practical knowledge that surgeons in Australia are in need of. Many a man leaves his University crammed with the details of antiseptic surgery as practised in large hospitals. Force of circumstances sends him to the Australian Bush, where sooner or later he is called upon to treat a case of suppurating appendicitis, a strangulated hernia, or a ruptured tubal pregnancy. Instead of attacking these rapidly fatal conditions, he temporizes, and the patient dies in due course. That man does not lack the technical skill to perform the requisite operation; he simply shrinks from

attempting a section in a Bush cottage because he is not surrounded by tiled walls and glass tables, and he fears that he therefore cannot operate with 'strict antiseptic precautions.'* He fails to recognise that hot water, soap and soda, a bistoury, a few forceps, a needle, a few pieces of boiled silk, together with half a dozen boiled pocket-handkerchiefs, are all he wants, and these can be prepared for an operation in a settler's hut (provided the surgeon can obtain a vessel and some hot water) with as much success as if he were in a well-equipped laboratory; and when once prepared, what is to prevent him from placing his patient on a table and operating with success?

This portion of our essay will, we hope, also be useful to many men who are unattached to any hospital, and who, nevertheless, have sufficient skill to do section work at their patient's home. This class of surgeon is largely on the increase, for the day has passed when section work is the monopoly of a few specialists. No doubt there is an evil and a danger in this, for many men, recognising the ease with which they can render the instruments and ligatures aseptic, now attempt operations they are not fitted to perform, and so commit the errors others were guilty of years ago when 'Listerism became a fetish, a royal road to surgical success, by which men ventured to travel in surgery whose hands fitted them only for field labours' (Tait).

The Sterilizing Room at the Surgeon's Residence.

A small room with bare floor, or a plain linoleum and kalsomined or painted walls, will be quite suitable. Should it happen to have a sink in it, so much the better; pictures and lumber are, however, out of place.

It should be equipped with a kitchen dresser, and preferably one with glass-doors before the shelves. Besides this, two or

* 'These words, "strict antiseptic precautions," have been a kind of mystic writing on the wall. . . . Those who come after us will read with interest of the operating theatre built like a diving tank, of the glass table for the patient, of the exquisite ceremonial of washing on the part of the operator, of the rites attending the ostentatious cleansing of the patient, of the surgeon in his robes of white mackintosh and his india-rubber fishing-boots, and of the onlookers beyond the pale, who are excluded, with infinite solicitude, as septic outlaws. . . . This exhibition may be scientific, but it is no part of surgery. It is more allied to a fervent, idolatrous ritual brought down to the level of a popular performance' (Treves, quoted by Bantock).

three small tables will be required. These should have plain, unvarnished tops so that they can be well scrubbed, and the wood may be further whitened by pouring a strong solution of oxalic acid on it, and this is allowed to sink well in.

There should be a good gas-supply pipe with a composite burner, so that while the gas burns to light the room, a rubber pipe may be fixed below so as to be connected with a Bunsen or a Fletcher burner.

The apparatus for sterilizing the instruments may be a simple fish-kettle with a tray, or it may be the well-known apparatus of Arnold or Schimmelbusch. Should the surgeon live in some remote country place any of these sterilizers may be heated by methylated spirit instead of gas.

Half a dozen enamel-ware dishes and basins of all sizes should be kept in the room, and these are sterilized by placing the smaller one in a nest in the largest basin and boiling the set. They may be stored in canvas washing-bags, and before being used they should be rinsed with boiling water and sublimate solution.

As an abundant supply of hot water is requisite, this may be boiled in the kitchen, and stored in agate-ware boilers, or water-cans, one of which can be kept heated by being placed over the Fletcher burner, while the other is allowed to cool. The water can be mixed in, and transferred by, enamel jugs.

Various sized glass jars with ground-glass stoppers are to be prepared and stored, so as to be ready for ligatures and sutures, while a few large jars, such as are used for holding preserved fruit, will be found very useful for holding the sponges or sponge-cloths. In purchasing these jars a supply of rubber-rings should also be obtained in order to keep the lid water-tight. These jars are prepared by being boiled in soda solution; if, however, they are taken directly from the soda solution and allowed to dry, they will never look clean; they must always be rinsed in plain hot water to free them from the soda; they may then be dried in the apparatus presently to be described.

To pick bottles and instruments from the boiling solutions, a pair of nickel-plated tongs will be found very useful.

Glass-reels can be bought at any instrument shop, and these are useful for rolling silk and gut upon.

If the surgeon intends to prepare his own catgut, then he must provide himself with various chemical disinfectants. We find

that what we use chiefly now is a bottle of ether and of absolute alcohol, a few hundred soloids of iodic hydrarg. or corrosive sublimate, the oil of juniper-wood, some bichromate of potash, and a few ounces of sulphurous acid.

In order to disinfect the hands there should be two jugs and enamel basins with a supply of soloids of iodic hydrarg., or a bottle of permanganate of potash and one of oxalic acid.

Preparation of Instruments.

The instruments are sterilized by being boiled in a 1 per cent. soda solution.

After performing an operation in a private house, it is well to direct the nurse in charge of the case to wash the instruments in cold water and dry them. It is a great mistake to pack up the instruments with blood and pus on them, as it only increases the labour of cleansing them afterwards.

On returning home the surgeon hands his instruments over to an attendant. To set to after a long day's work to cleanse one's own instruments is a great mistake, and a sad waste of energy. The surgeon will therefore do well to employ a nurse who will attend at his house at certain hours to prepare his instruments, or he may instruct some member of his household to do the work.

We ourselves find the best plan is to hand over the soiled instruments to an intelligent maid-servant, who retires to a small apartment, where she washes them in cold water. If hot water is used, it is more difficult to remove the blood, and the hot water causes the blood to stain the instrument. After all the blood is removed, the instruments are placed in hot water, the stems are rubbed with a piece of gauze and monkey soap, while the crevices are brushed with the same soap. The instruments are now handed over to another member of the household (a relation), who has charge of the sterilizing room. She places the instruments in the sterilizer, which contains a boiling 1 per cent. soda solution. After being boiled for ten minutes, the instruments are lifted out and placed in boiling water without soda. They are then rapidly dried on a towel. If the instruments are dried directly from the soda solution they appear discoloured, and often have a white film of soda over them. If when drying the instruments we discover any stains of blood in the indenta-

tions or locks, they should be scraped off, or brushed off with monkey soap, and the instrument should be returned to the sterilizer for a minute.

Needles are boiled in a perforated metal-box (Fig. 58), knives on a rack (Fig. 59).

The instruments may be dried on gauze towels that have been

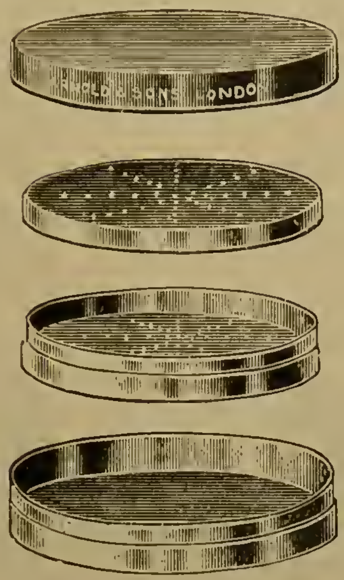

FIG. 58.—Box for holding Needles in Sterilizer.

boiled and hung up to dry, or they may be dried on towels as they come from the laundry. We must confess that we have never troubled to sterilize towels after they come from the laundry, and we always dry and carry our instruments to, and use at, an operation the towels as they come from the laundry.

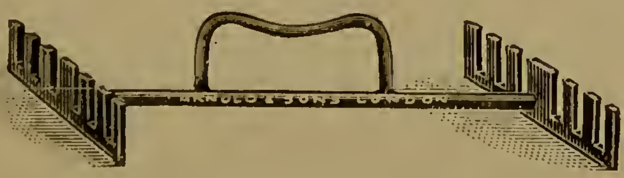

FIG. 59.—Rack for holding Scalpels in Sterilizer.

We, however, never use the towels found in patients' houses; these often leave an offensive smell on the hands after using them.

After the instruments have been dried they should be placed in a glass cabinet, or wrapped in some washing material and stored away in drawers or biscuit tins, on the side of which is a label to denote the exact contents; these tins can be easily sterilized from time to time.

Preparation of Ligatures and Sutures.

Catgut.—We have tried several methods of preparing catgut, and have now adopted the following plan: We purchase Arnold's catgut sold in bottles of carbolic oil.* We transfer it from the oil to ether, and allow it to remain therein for some weeks; it is then placed in an alcoholic solution of iodic hydrarg. (1 in 800 alcohol and 200 parts of water), and after changing this several times the gut is either preserved in this, or further hardened in bichromate of potash. It can be made very supple by being placed in juniper oil. The details of this latter method we have given in the first part of this essay.†

We consider that one may perform any section and not need to use catgut at all, as thin silk does admirably for tying small vessels and thin pedicles. Those surgeons who live in the

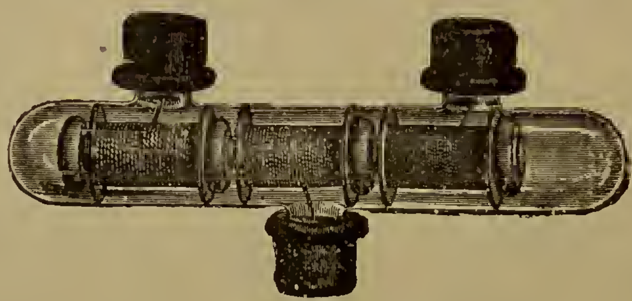

FIG. 60.—Catgut in Tank Package.

country and who cannot depend on a regular supply of sterile gut will therefore be at no loss, provided they can obtain thin silk.

We find that Nos. 2 and 0 catgut are the sizes that are most useful for section work. We prepare No. 2 as we have just related; but we have found the tank packages of Ellwood Lee's No. 0 catgut in alcohol so sterile and so convenient that we do not trouble to prepare this small-sized gut. We have tested No. 0 so often by using it as a subcuticular suture that we can strongly recommend it (Fig. 60).

The No. 2 catgut we do not roll on reels; we find it more

* Of late we have use Ellwood Lee's gut; this requires no ether.

† We have always looked upon herniotomy and Alexander's operation as good test operations for catgut. Since we began to write this essay we have opened the groin eighty times, and have used gut prepared by the above method in every instance; the results showed that this gut was perfectly aseptic in every instance.

convenient to cut it into pieces 18 inches in length. Previous to an operation we take out of the stock-bottle as many sutures as we think we shall require, but in case we should underestimate the number, we always carry two emergency bottles, each containing a dozen sutures. If we touch any sutures at an operation and do not use them, we do not re-sterilize them, but discard them.

Silk.—We have used floss, braided, and twist silk; the braided we have given up, as it has no advantages.

The floss silk we still use for soft pedicles in septic tubal cases, while the twist silk is so strong that it can be used for almost any class of work to the exclusion of all other sutures.

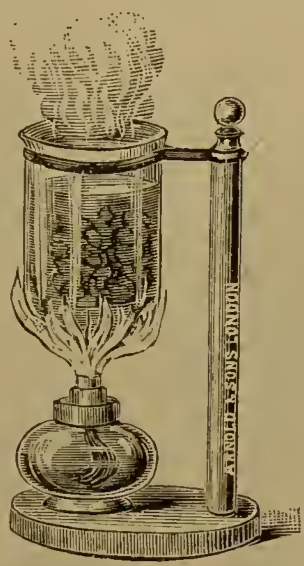

FIG. 61.—Sterilizer for Ligatures.

In preparing silk for pedicles we adopt the following plan: We take a glass reel, on to which we roll 36 inches of floss silk or twist silk; this, when introduced into the broad ligament, gives two ligatures 18 inches in length, which length is ample for an interlocking ligature, or for separate ligatures.

We place the reel with others in an enamel or glass vessel (Fig. 61) filled with boiling water, and boil it steadily for fifteen minutes. Each reel is then lifted out with sterile tongs and placed in a wide-mouthed, dry bottle, which has been well boiled. The bottles are placed without their stoppers on the glass shelf of the small stove presently to be described. After the silk is thoroughly dried, the stoppers are fitted into the bottles and they are stored away. This routine has some advantages: we make certain that the bottles, stoppers, reels, and silk are sterile, and

the silk is not handled after being placed on the reels, where it will keep indefinitely, and does not become rotten, as it assuredly does if kept in fluid.

Before starting for an operation, we select as many bottles of silk as we think we shall require, remove the stoppers, insert a small piece of a soloid of biniodide of mercury, and then pour in some boiling water. This not only softens the silk, but makes its sterility doubly sure; and such silk can be handled all through an operation with impunity, as we have shown in a former chapter.

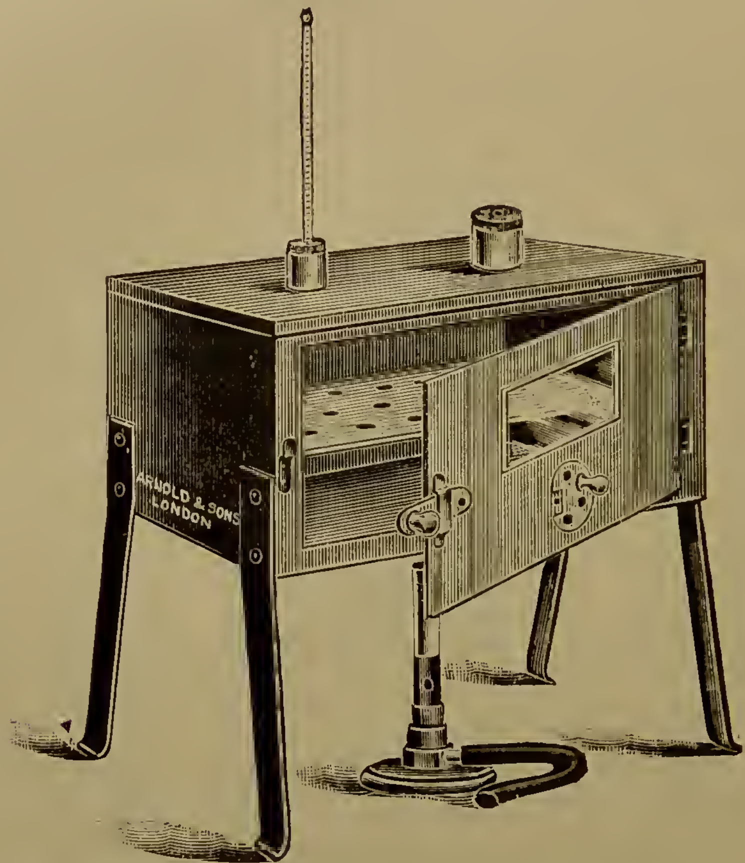

Fig. 62.—Hot-Air Stove for drying Silk and Bottles.

Whatever the operation may be, it is wise never to start for any section without taking a stock-bottle containing six or eight reels of dry silk of various sizes, so that we may be prepared for any emergency. We have found small jars containing a movable metal frame-work on which three or four reels can revolve useful.

The surgeon will soon discover that dividing his silk up in the manner just described is economical, and works very satisfactorily. Nothing, however, is more foolish than to take a large quantity of silk to an operation and place it in a dish and allow it to be

contaminated with handling. The silk must then be brought home—often blood-stained—and re-sterilized. This practice not only ruins the silk, but exposes it unnecessarily to infection.

The fine silk may be divided in lengths of 72 inches, so that each reel will give us six ligatures 1 foot in length. Two reels of such fine silk may be placed in one bottle.

We formerly had some difficulty in drying our silk without exposing it to infection; we accordingly had the following small drying-stove made at a tinsmith's, and we find that it answers the purpose admirably, not only for drying silk, but also for drying jars, dressings, drains, or anything else that has been submitted to steam sterilization.

This stove consists of two tin cases, the inner being separated from the outer by an air-space. A door is placed on one side, and there are two glass movable shelves. The roof is perforated to admit a thermometer, kept in its place by a rubber cork, while the floor is composed of a sheet of cast-iron, in which are a few perforations so as to make a good draught. A Bunsen burner heats the iron floor, and the hot air rushing up over the glass shelves escapes by means of some perforations in the roof of the inner case. This heated air then circulates between the two cases, and finally escapes by a shaft at the back. The stove shown in Fig. 62 will also answer the purpose well.

By heating the stove and keeping it at about 160° F. for an hour the silk becomes perfectly dried, and in no way damaged or brittle.

Silkworm Gut.—We always use this material for closing the abdominal wound. The coarsest variety will seldom break, though it is more difficult to tie unless it has been well soaked for fifteen minutes before using it.

We prepare the gut by first washing it and then boiling it for ten minutes, after which it is placed in a sterilized bottle.

Twenty additional strands can be so prepared, and the bottle placed in the drying stove; this will constitute a stock-bottle for an emergency.

Sponges.—We have given up using marine sponges, and now use gauze sponges only. These are cut from the rolls of gauze supplied by Ellwood Lee, and are then hemmed with ordinary sewing cotton, boiled for an hour, and then placed in a fruit-jar in a watery solution of biniodide. To transport these fruit-jars to a distance the lid must be made secure by inserting a rubber

ring between it and the neck of the bottle. In purchasing the fruit-jars it is well to buy a few dozen extra rubber rings, which can be easily sterilized by being boiled.

Dressings.—For the dressing we use in private operation a large piece of iodoform gauze. We do not prepare this gauze ourselves, but use the gauze prepared by some reliable maker, such as Ellwood Lee, which is sold in air-tight jars, and cartons. In hospital work we always use plain gauze, and the surgeon can readily prepare this by sterilizing a few squares in the tray of his fish-kettle; it is then transferred to a fruit-jar, which is placed in the drying-stove for an hour.

The surgeon should never set out for any section without taking with him several long strips of plain gauze, which have been sterilized and dried and stored in well-stoppered bottles. These strips are used for gauze drainage.

We do not sterilize the squares of cotton-wool used for the dressing, but cut it and use it as it comes from the stores. Frequent bacteriological examinations have shown that good cotton-wool is generally sterile. The binder we use as it comes from the laundry.

CHAPTER XVII

PACKING AND TRANSPORTING THE INSTRUMENTS, AND PREPARATION OF A ROOM FOR AN OPERATION AT A PRIVATE HOUSE

Packing and Transporting the Instruments.

When called upon to perform a section at a private house, our first care is to pack and transport our sterile instruments, dressings, and dishes in such a way that they will be ready for use when we arrive at the house.

If the operator is a man of means he should have two sets of instruments—one for general use, and one set that he shall keep ready packed for emergency operations.

Before selecting our instruments the hands should be well disinfected.

It is never wise to depend upon the memory alone, for if the operator has to hurriedly pack his bags he may possibly forget some important instrument. We have known a surgeon arrive at a house to amputate a breast, only to find when about to commence the operation that the scalpel has been forgotten.

Always, then, have a list, and take the instruments from the cases in the order in which they stand on the list.

Necessary Bag 1.

Knife.
Forceps: Dissecting, hæmostatic, pressure, Liston's, sponge.
Retractors.
Scissors.
Needles: Straight, curved, plain, handled, pedicle, aneurism.
Needle-holder.
Sutures: Silk, catgut, silk-gut.
Sponges.
Dressings: Gauze, cotton-wool, binder, safety-pins, plaster.

Apron. Towels.
Nail-brush. Soap. Soloids of sublimate and biniodide.

Necessary Bag 2.

Dishes. Instrument trays. Bowls. Enamel jug.
Mackintosh.

Accessory Bag.

Razor.

Aspirator. Trocar. Ascites tube. Catheter. Sound.

Hypodermic case, with tabloids of strychnine, morphine, and atropine.

Brandy. Peroxide of hydrogen. Iodoform. Boracic powder. Adrenalin. Carbonate of ammonia. Tinct. digitalis.

Glass and rubber drainage-tubes.

Sucker and tube.

Glass jar with gauze drains.

Needle-case: Two transfixion pins and serre-nœud.

Rubber gloves. Rubber tissue.

Stock-bottles with silk, catgut, and silk-gut.

Large funnel, with 6 feet of rubber-tubing and trocar (for transfusion).

Tabloids of sodium chloride.

Enema syringe. Hand syringe to hold 4 ounces.

Trendelenburg frame.

The dishes, bowls, and mackintosh may be slipped into a long canvas bag, the mouth of which is securely closed with a running string, and then turned back over the body of the bag. These bags are easily sterilized by being boiled in soda after each operation.

The instruments should be packed into two leather bags, lined with a movable linen lining. One of these contains all the instruments likely to be used in a straightforward section, while the second bag contains only those accessory instruments that may be required, as well as stock-bottles with silk and gut in case the surgeon underestimates his wants.

While selecting the instruments we lay them on a towel, and after picking out what we shall require, we endeavour to run through the operation rapidly, pointing to each instrument that we shall use during each step, so that we may supplement it with another if necessary.

We then pack the blunt instruments in one towel, and the

knife and handled needles in another. The sewing needles are best carried in a small glass tube plugged with cotton-wool, or a metal matchbox is handy for placing them in.

The gauze sponges and dressings may be carried in fruit-jars, while the silk, catgut, and silk-gut are carried in wide-mouthed bottles with ground-glass stoppers, which are arranged in the bag so that they will not collide with one another and break.

Preparing the Room for the Operation.

When called upon to perform a section in a private house, the case is seldom so urgent as to require immediate operation; a ruptured uterus or a ruptured tubal gestation may, however, admit of no delay. Usually we have ample time at our disposal, and are thus able to send forward a nurse to prepare the room and the patient.

The room and the air in it has little to do with the result of the operation;* but if we are compelled to operate in a hovel, it is wise for us to act as though the walls, tables, doors, and windows were covered with septic germs, and in order to operate successfully we must take extra precautions.

If, however, we are called upon to operate in the house of a well-to-do family, we may go there without hesitation; those surgeons alone demur whose ideas have been cramped by a teacher who shields himself from his audience by a glass screen, plugs his ears with antiseptic wool, hides his hair with a cap, shades his mouth and nostrils with a filtering mask, and places a sheet over the anæsthetist's head.†

The surgeon should visit the patient's house with the nurse a day or so before the operation, and should instruct the nurse as to the preparations that will be required. Here, again, a list is

* Some years ago we used to operate at a hospital where, for want of space, the sections were done in a room which served as a surgery, a waiting-room, dispensary, and museum for pathological specimens. The air blew in through the open windows during the operation from a neighbouring grave-yard, the towels used were straight from the laundry, the dressing from the shop. Of the first fifty gynæcological sections that we did in that room only two died, and they were both pus cases—cases that would probably die if we operated on them now.

† 'The remarkable and extravagant preparations with which some surgeons now approach an operation, the cleansings and the washings which precede the laying on of hands, smack a little of fetish worship, and foster the cult of the surgical Pharisee' (Treves, *British Medical Journal*, August 4, 1900).

invaluable, for the nurse can then have no excuse for neglecting to procure and arrange any necessary articles.

The patient's bedroom should be as large as possible, as it is to contain two people for a considerable space of time. It should be chosen so as to get the morning sun, and it should be well ventilated. There should be a single bed for the patient, and another for the nurse; and on the morning of the operation the patient's nightdress and the bedclothes should be changed for fresh ones, and a mackintosh should be slipped under a wide draw-sheet, while four blocks or bricks may be left at the foot in case the bed needs raising after the operation.

The room selected for the operation should be well lighted, and we should choose the room that is least inhabited, as it will contain the fewest germs.

If the floor is covered with linoleum this should be scrubbed; if covered with a carpet this should be removed, and the floor scrubbed.

All curtains and surplus furniture should be taken from the room, and if there are any large pictures it will be well to take these down; in short, have as little furniture and as few ornaments, hangings, and pictures in the room as possible, as these are mere dust receptacles.

All parts of the room are to be gone over so as to get rid of the surplus dust, and then the window-casings, doors, chandeliers, cornices, and ledges are to be wiped with a wet sublimate cloth, after which the Alformant lamp may be placed in the room, and lighted so as to help in the disinfection.

These preparations should be made on the day preceding the operation. If, however, we are compelled to operate at a few hours' notice, it is well not to disturb the carpet, or the pictures, as we should only fill the air with dust, and do more harm than good.

The furniture required for the operation consists of tables and chairs.

The kitchen-table is the one usually chosen for the operation. We have generally found it very unsatisfactory, as it is always too low and too wide; and if the operator is a tall man, he will soon discover that bending at a long operation makes his hand very unsteady,* wearies him unnecessarily, and ruffles his temper, three factors which are opposed to good surgery.

* An operator should not even carry a heavy instrument-bag for any distance before an operation for the same reason.

Usually narrow dressing-tables answer better, one being placed at right angles to the other.

Tait always used two trestles and a thick deal board 6 feet

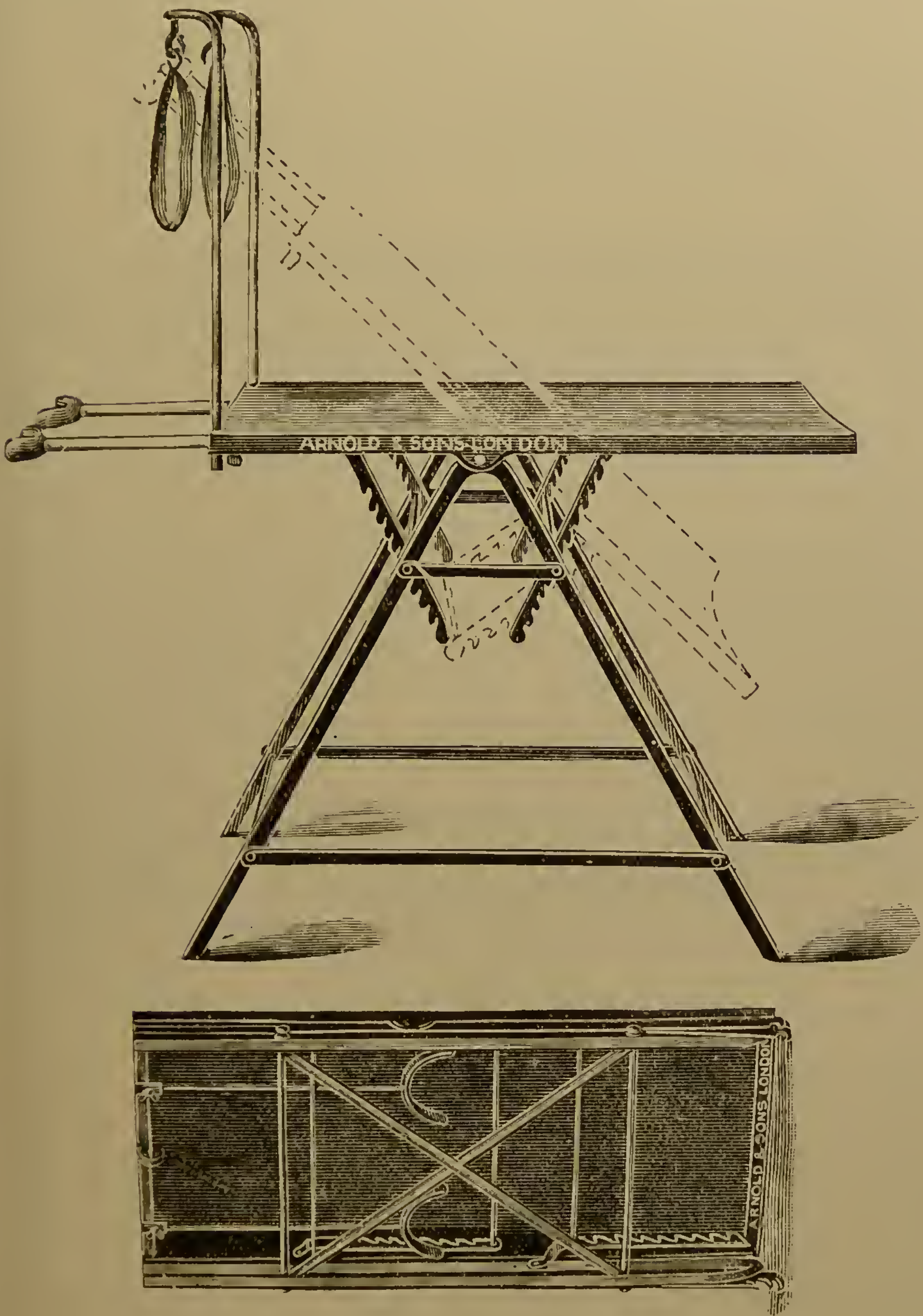

Fig. 63.—Portable Operation-Table.

long. These things make an excellent table, and one that can be placed in any room without difficulty.

There are several portable tables made. One of these, known

as Edebohl's table (Fig. 63), can be packed into a small compass, and only weighs 34 pounds, while there are numerous portable frames, to be had at a small cost, which can be affixed to any ordinary table so as to allow of the patient being elevated into the Trendelenburg position. In an emergency this position may be improvised, as shown in Fig. 64.

Some time before dressing the operation-table it should be well scrubbed, and the clean sheet that covers the blanket on which the patient lies may be allowed to drop well over the edges of the table.

Beside the operation-table the nurse will require a small one for her sponge-basins, and the surgeon must have another for his trays and instruments. A chair will do for resting the basin on that the surgeon uses for his hands during the operation, and another chair will do for the anæsthetist's bottles.

In preparing for the operation, the nurse's first care will be to inspect the kitchen kettles, and ascertain if she can obtain an adequate supply of hot water. Many operators, recognising the importance of a good supply of sterilized water, prefer to despatch to the patient's house a portable sterilizer which will supply 5 or 10 gallons of water. After boiling the water in the sterilizer, or in the kitchen kettles, some of it should be set aside in a covered vessel to cool, while the rest may be kept on the boil until required. A most convenient and handy way of managing the water at a private house is to send to the nurse two large enamel-ware water-cans, one of which will be used for the cold, the other for the hot water, and this supply will be ample for any ordinary section. As these water-cans may not be forthcoming, the nurse will have to use the bedroom jugs as her reservoir, and these she will be careful to rinse with sublimate solution after having washed them well in hot soda-water.

As the hour appointed for the operation draws near, the nurse should refer to her list, and make certain that she has not forgotten anything. She should attend to the patient, who is waiting in her bed, with false teeth removed, shaved pubes, emptied bowel, and disinfected vagina, while the area to be operated upon is covered with an antiseptic pad. Nothing remains now to be done but to empty the patient's bladder, and inject morphine or strychnine, if the operator has ordered these.

Glancing round the room, she will see that the operation-table

Fig. 64.—The Trendelenburg Position.

To face p. 164.

is placed in the best light, and that the bottles that are warming the clothing on it are *well covered* and *securely corked*, and that on either side of the operation-table are placed the two small tables, while a bath and a bucket are conveniently placed for receiving the used sponge-water, or for catching the irrigating fluid, or the contents of the cyst if the case is one of ovarian tumour. Having filled her hot-water cans, the nurse should now begin to sterilize her hands, for though they will become contaminated before the operation commences, still, the first preparation makes it easier for her to disinfect them later on. Added to this, when the surgeon arrives she can take his bags from him, and, after removing the basins and trays, proceed at once to wash them with sublimate solution, while the surgeon is engaged in sterilizing his hands, using the nail-brush and soap that he has brought with him to the patient's house ; for no surgeon should ever use any nail-brush but his own, and this may be conveniently carried in a small case, so that he will not be compelled to lay it on the washstand.

When the surgeon has sterilized his hands, he dons his apron, and then proceeds to lay his instruments out on the trays and to arrange his ligatures, while he hands his sponge-jar to the nurse, who empties the contents into the basins she has just prepared for them.

The dressing and binders need not, however, be removed from the surgeon's bag until they are needed at the termination of the operation.

During these preparations the anæsthetist has been administering the anæsthetic in the neighbouring room, and when the patient is ready she is carried in and placed on the table, and the nurse proceeds to arrange the blankets and hot bottles around her, at the same time removing the antiseptic pad which covers the operation area, and fixing the mackintosh over the pubes.

The operator, whose hands are sterilized now, arranges the towels about the field, and the nurse, having filled the sponge-basins with hot water, proceeds to sterilize her hands once more—a process that is rendered easy, since she has already sterilized them, as mentioned above.

As the nurse will have to fill her sponge-basins during the course of the operation from her hot-water cans, whose handles may not be sterile, she should always have two small bags, made of some washing material, suspended from her waist, into which

she can slip her hands when she touches the hot-water cans or empties her basins.

Should there be two nurses present, one will keep her hands sterile to help the surgeon, while the other will fill or empty the sponge-basins, or replenish the hot-water reservoirs from the kitchen. Should there be no second nurse, someone must be within call to fill the hot-water cans if necessary. It would be impossible for the nurse who is assisting the operator to leave the room to do this.

If it so happens that the surgeon is compelled to operate in a house where he is unable to obtain a satisfactory supply of hot water, and where he has neglected to send on his own basins, his safest plan will be to spread his instruments out on one of his own towels, and to take his sponge-cloths and use them for isolating the field of operation, taking them *directly* from his jar. For mopping purposes he may use balls of cotton-wool that have been steamed in his fish-kettle, or he may use small pieces of dry gauze. By these means he can be fairly independent of basins and water during the section, though, of course, he will require one bowl for disinfecting his hands, unless he uses sterilized gloves.

Should, however, he determine to use the basins or plates of the house, the nurse should boil them in the clothes-copper, which will probably be found the most aseptic vessel in the house.

Should the surgeon require to irrigate the peritoneal cavity, he will do so by pouring in the hot water from the enamel jug, which he should never forget to bring with his instruments, even if he neglects to bring bowls and dishes, while transfusion may be carried out with the funnel and rubber-tube; this is stored among his accessory instruments.

At the conclusion of the operation the dressings are taken from the surgeon's bag, and the binder is applied, and while the surgeon and the anæsthetist remove the patient to her bed, the nurse may rapidly wash the instruments in soda-water and pack them in the surgeon's bags.

CHAPTER XVIII

THE BED AND BEDROOM

In all hospitals there should be a special room set apart to receive the patient after leaving the operation theatre.

This will be found a much better arrangement than removing the patient at once to the ward. She enjoys the quiet of the room, she has the undivided attention of her nurse, and she is not disturbed by cases operated on a day or so after.

This special room should be large and airy and well ventilated. The window should be wide, and there should be a second smaller one above, which may be used as a ventilator.

The window should be guarded either by bars or by a movable wire net. This precaution should never be neglected, for patients after a section may, in a delirium or during actual mania, attempt to commit suicide when the nurse has left the room.

A washing-blind will best regulate the light; venetian blinds should not be employed inside the room, as they collect dust, and it is impossible to keep them clean.

The walls should be painted; a figured paper serves only to excite a patient if she is delirious.

The floor may be polished, or it may be covered with linoleum, but never with a carpet.

There should be two single beds in the room, for it is a great relief to the patient to be changed from one bed to another after the first few days. These beds should be 3 feet wide and about 27 inches in height; a low bed is inconvenient for the surgeon, and a hardship to the nurse.

The best type of bed is that known as Lawson Tait's. It is made entirely of metal, and the woven wire spring mattress is very strong and slightly convex, so that it does not give in the centre and allow the patient to lie in a trough. A bar should overhang the head of the bed, as a chain attached to this

enables the patient to lift herself after a few days, when the draw-sheet or the binder is being changed. This bar is also useful for hanging the reservoir on when performing transfusion after the operation.

A firm horse-hair mattress is required. Harrison Cripps recommends a water-bed, but this is not a comfortable bed to lie on, and it often makes the patient feel sea-sick ; it is only to be employed when the patient is much emaciated, or where she is very heavy and is quite unable to move on to her side, but lies continually on her back.

A 'flock' mattress is an abomination, and should never be employed ; it is most uncomfortable, and in hot weather, as the patient sinks into it, it causes her to perspire.

In preparing the bed for the patient a mackintosh sheet is spread on the mattress, and over this is laid a sheet, and then a draw-sheet is fixed with safety-pins.

Some patients complain of the mackintosh sheet making the bed too hard, but experienced nurses object to a blanket being placed between the sheet and mattress, believing with Florence Nightingale that 'it retains the damp, and acts like a poultice.'

An upper sheet is not required at first, a thick blanket being placed next the patient when she is put to bed after the operation. A sheet may, however, be placed outside the blanket to act as a bed coverlet.

There should be several pillows and cushions of different sizes and shapes, which can be placed under the patient's head, or which may be tucked in under her sides.

At the foot of the bed several blocks of wood or covered bricks are placed so that the foot of the bed may be raised when required.

The bed should be so placed that the nurse can easily get round all sides of it, and it should be situated so that the light from the window falls across it, and does not shine into the patient's eyes.

Besides the bed, the room should contain a few chairs and two tables, one of which the nurse uses for her note-book, and the other table is used for the patient's food and drinks.

In one corner of the room there should be a towel-hanger (Fig. 65), a wash-basin with hot and cold water laid on, and a bottle of soloids of biniodide of mercury, so that the surgeon and the nurse may disinfect their hands.

The room should be kept at a temperature of 70° F., and should be warmed in cold weather by a gas-stove connected with a flue. If the fireplace is closed with tiles very little gas will be consumed in keeping the room at an even temperature. Open grates are not cleanly; they fill the room with dust, and are not economical, while a large part of the heat is wasted, and the labour of attending to them in a large private hospital is very considerable.

Ornaments, curtains, and pictures are to be conspicuous by their absence. They may make the room look pleasant, but they attract dust, and so they increase the labour of keeping it

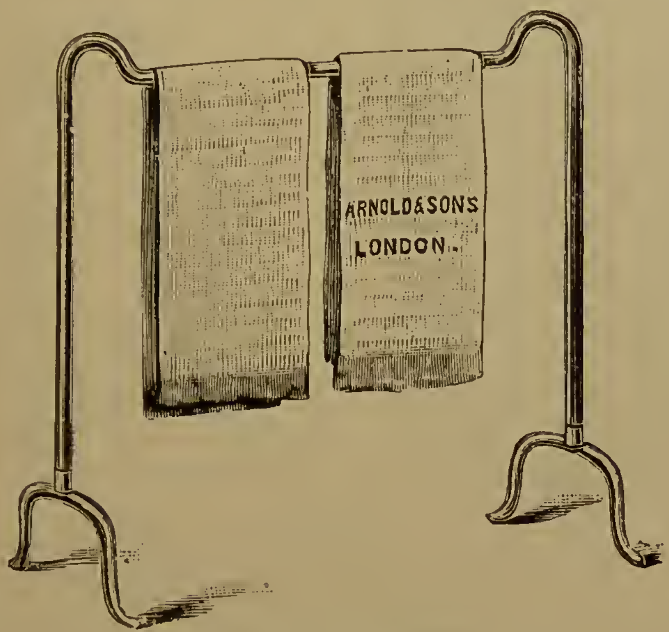

Fig. 65.—Towel-Hanger.

clean—for such a room must be dusted every morning with a damp cloth.

A cupboard with several shelves will serve to hold the following articles, all of which may be needed during the first few days of the after-treatment: Three glass irrigators—a small one for nutrient enemata, one for soap and turpentine enemata, and the third for normal saline fluids used for submammary transfusion; a ball-syringe for rectal injections of 3 or 4 ounces; a rectal tube used for aiding the passage of flatus; a stout, soft catheter for high rectal injections; a glass catheter for the bladder; two pairs of scissors and dissecting forceps; a probe; enamelled trays for holding dressings, and a few small enamelled basins; two tins containing sterilized dressings, towels, and binders;

hypodermic syringe and needles with tubes containing strychnine, morphine, and atropine; bottles containing tincture of digitalis, glycerine, turpentine, adrenalin, carbonate of ammonia, sulphate of quinine, powdered alum, croton oil, calomel (1-grain tabloids), capsules containing calomel (3 grains), with pulv. elaterii co. (2 grains), sulphate of magnesia, stock-bottle of saline solution,

FIGS. 88, 89.—Feeding-cup for administering Nourishment in the Recumbent Position.

brandy, peroxide of hydrogen, iodoform, boracic acid, vaseline, and soap for enemata. A bed-pan is kept in the adjacent lavatory.

In order that the nurse may administer drinks to the patient with ease, she should have a wooden spoon for hot water, and a glass shaped as shown in Figs. 88 and 89.

CHAPTER XIX

THE CASE-BOOK

Previous to the operation the surgeon should have drawn up a complete history of the case, and should have written out his diagnosis, so that he may compare it with what he actually finds at the time of the operation. The case-book is then handed over to the nurse, so that she may continue the notes of the case.

Some operators keep dictating to an amanuensis their observations during the progress of the case, and by this means their notes often acquire a great value to those who have had an opportunity of examining the case previous to the operation.

If, however, the operator does not adopt this plan, he should take the first spare moment to write down in the case-book the disease and the operation performed, and he should add a sketch so that he may recall the condition to his mind months or years afterwards.

As we have already said, we use at Lewisham two long rubber stamps. One contains the words Date, Hour, Pulse, Temperature, Respiration, Bowels, Urine, Medicine; and the other Nourishment and Remarks. The first is stamped along the top of the left-hand page, while the second is stamped on the top of the right-hand page of a long exercise-book, and the nurse rules pencil lines down the pages between each word.

But while these headings are of the greatest importance in indicating the progress of the case, they are not sufficient, and therefore, in order to teach the nurse to observe and to increase the value of the notes, she should be given the following printed

list, or one should be hung up in the room where the section cases are usually attended to to guide her :

Date. Hour. A.M. P.M.

Pulse. Temperature. Every two hours during the first twelve hours, then every four hours until the fourth day.

Respirations.

Saline transfused.

Fluids. Nourishment. Stimulants. Enemata. $\begin{cases}\text{Saline.}\\ \text{Nutritive.}\end{cases}$

Medicines. Hypodermic injections. $\begin{cases}\text{Quantity.}\\ \text{Frequency.}\end{cases}$

Urine. Catheter passed. $\begin{cases}\text{Quantity.}\\ \text{Frequency.}\end{cases}$

Bowels. Purgatives. Enemata.

Distension. Expulsion of flatus. Passage of rectal tube.

Borborygmi. Belching. Retching. Vomiting. Hiccough.

State of tongue. Aspect of face. Colour of conjunctivæ.

Amount of sleep. Sedatives administered.

Pain.

Restlessness.

Delirium. Rigors.

Cough. Expectoration.

Skin. Perspiration. Rashes.

Drainage-tube. $\begin{cases}\text{Amount of fluid withdrawn by sucker.}\\ \text{Character of fluid, colour, etc.}\\ \text{When the tube or gauze was withdrawn.}\end{cases}$

Onset of metrostaxis.

State of stitches and wound. Date of removal of stitches.

Date of moving patient into ward, of her leaving bed and hospital.

The surgeon should constantly inspect the case-book, and should observe if the nurse is discriminating between a.m. and p.m.—a simple point, but one they frequently fail to note.

It is also an encouragement to an intelligent nurse when the surgeon reads her notes attentively, and directs her attention to particular points.

The surgeon should never rely on the nurse's memory in giving his instructions, but he should write the headings down in the case-book ; and this should never be omitted when he has ordered hypodermic injections of such drugs as strychnine and morphine.

At the end of each twenty-four hours from the time the patient is placed in bed the nurse should draw a thick line under the foot of her notes, and under this she should make a summary for the preceding twenty-four hours, indicating in this summary the highest and lowest temperatures and pulse-rates, the amount of urine passed, the number of stools, the drugs given, the nourishment taken, and the sleep obtained.

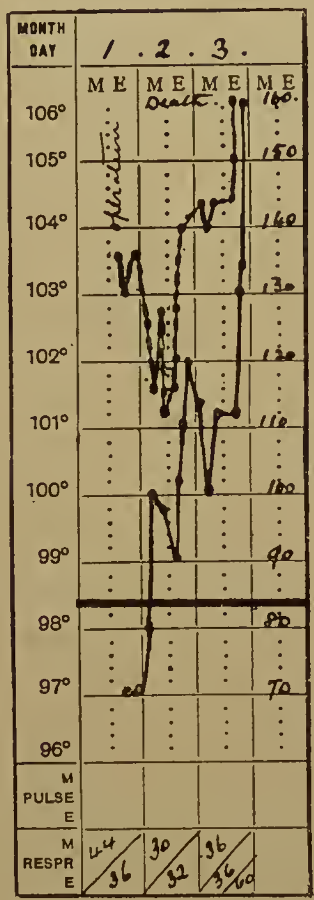

Fig. 66.—Chart of a Case after Removal of Pus-tubes; Death from Septic Peritonitis.

The following case, taken at random from one of my note-books, will serve as a guide to the points attended to above.

The patient died at the Lewisham Hospital from peritonitis after the removal of a double pyosalpinx. Each tube contained about 4 ounces of pus, and one of the tubes burst during its enucleation. The pus was very virulent, and the case was regarded as hopeless. In the present day we should reopen the abdominal cavity, wash it out, and fix a coil of bowel in the wound so as to inject aperients. The temperature chart is shown (Fig. 66).

SPECIMEN ENTRY FROM AUTHOR'S CASE-BOOK

Date.	Hour.	Pulse.	Temperature.	Respiration.	Bowels and Urine.	Medicine.	Nourishment.	Remarks.
1900. April 19 (1st day)	P.M. 5.35	—	—	—	—	—	—	Patient put to bed; transfused saline solution ℥xxx under each breast
	5.45	136	97	44	—	—	—	—
	6.5	—	—	—	—	Hyp. strych. ♏v	—	—
	6.30	—	—	—	—	—	Liq. peptonoids per rect. ℥j (retained)	Inclined to vomit; complains of pain; skin cold and clammy; hot bottles renewed; pulse very weak
	7.0	130	97	36	—	—	—	—
	9.0	—	—	—	—	Hyp. strych. ♏v	—	—
	9.30	—	—	—	—	—	Liq. peptonoids per rect. ℥j (retained)	Complains of pain and sick feeling; forehead bedewed with cold perspiration; skin cold and clammy; pulse very weak
	10.0	136	97	36	—	—	—	—
	10.30	—	—	—	—	—	—	Patient feels very faint
	10.40	—	—	—	—	—	—	—
	10.45	—	—	—	—	—	Normal saline per rect. ℥viij (retained)	Pulse much improved
	11.20	—	—	—	Passed catheter; urine normal	—	—	Skin warm; vomited mucus ʒij; expelled flatus by mouth; complains of pain

	11.30	—	—	—	—	—	—	In great pain; also complains of thirst; vomited bile-stained fluid ℥ss.
	11.50	—	—	—	—	Hyp. morph. gr. $\frac{1}{4}$; atrophine gr. $\frac{1}{150}$	—	Doctor visited; ordered morphine gr. $\frac{1}{4}$, atrophine gr. $\frac{1}{150}$
April 20 (2nd day)	A.M. 12.30	126	98	36	—	—	—	Patient fairly comfortable
	12.45	—	—	—	—	—	—	Slept ten minutes
	1.0	—	—	—	—	Amm. carb. per rect. gr. xx	Liq. peptonoids ℥ij; in warm water by bowel ℥iv (retained)	The injection was retained
	1.30	—	—	—	—	Hyp. strych. ♏iij	—	Pulse very weak
	2.0	—	—	—	—	—	—	Not sleeping, but very quiet; feels comfortable
	2.30	—	—	—	—	—	—	Renewed hot bottles
	4.0	—	—	—	—	—	Saline solution per rect. ℥viij	Gave saline ℥viij, which was retained
	4.45	116	100	30	—	Hyp. strych. ♏iij	—	—
	5.0	—	—	—	—	—	—	Patient restless, complaining of pain in right side; turned her on side
	5.20	—	—	—	—	—	—	Expelled flatus by mouth
	5.30	—	—	—	Urine drawn by catheter ℥iv; normal	—	—	Pain slightly relieved
	5.50	—	—	—	—	—	—	Passed rectal tube; flatus expelled freely
	6.0	128	99·8	30	—	—	—	Fairly comfortable; inclined to sleep; renewed hot bottles
	7.0	—	—	—	—	Hyp. strych. ♏iij	Liq. peptonoids per rect. ℥ij (retained)	Dozing, but not sleeping

SPECIMEN ENTRY—*continued*

Date.	Hour.	Pulse.	Temperature.	Respiration.	Bowels and Urine.	Medicine.	Nourishment.	Remarks.
1900. April 20 (2nd day) —*continued*	A.M. 10.0	116	100	30	—	—	—	Doctor visited; changed dressings, which were soaked through with serum; wound looks clean; good deal of abdominal distension; inserted rectal tube; no flatus passed
	11.0	—	—	—	—	Hyp. strych. ♏iij	—	—
	P.M. 12.30	116	—	—	—	—	Benger's Food by mouth ℥ss.	Food makes her feel sick; could not take it
	1.0	—	—	—	Flatus expelled	—	—	Inserted rectal tube; great quantity of flatus expelled
	2.0	120	99	30	—	—	Liq. peptonoids per rect. ℥ij (retained); sips of soda-water	Patient more comfortable
	2.40	—	—	—	—	—	—	Sleeping
	3.0	—	—	—	—	Hyp. strych. ♏iij	Soda-water ℥j	Slept ten minutes
	3.15	—	—	—	—	—	—	Complains of great thirst
	3.35	—	—	—	—	—	—	Tongue very dry; vomited clear fluid
	4.0	—	—	—	—	—	Liq. peptonoids per rect. ℥ij (retained)	Slept ten minutes
	4.20	—	—	—	Passed urine (normal)	—	Soda-water in sips	Expelled flatus by mouth
	5.0	116	—	—	Flatus expelled, also some mucus	—	—	Inserted rectal tube; flatus expelled freely, also some mucus

	5.10	—	—	—	—	—	—	Vomited clear fluid and mucus
	5.20	120	100·2	30	—	—	—	Washed mouth out with warm water
	5.30	—	—	—	—	Hyp. strych. ♏iij	—	Very restless
	5.40	122	—	—	—	—	Sips of soda-water	Sponged hands and face with tepid water
Summary for 1st 24 hours	—	136 112	100·2 97	44 30	Urine ℥xx; bowels O	Liq. strych. ♏xxviij; morph. gr. ¼; atrophine gr. $\frac{1}{100}$	Liq. peptonoids by bowel ℥x; saline by bowel ℥xvj; saline hypod. ℥lx; Benger's Food by mouth ℥ss.	—
	6.0	128	101	30	—	—	—	Patient very drowsy; face flushed; complaining of pain in abdomen, more severe in left side; expelled flatus by mouth; patient more comfortable
	7.0	—	—	—	Passed urine (normal)	—	—	Face not so flushed; great thirst; pulse still rapid; patient not so restless; skin not so dry; tongue very dry
	8.0	—	—	—	—	—	Milk and soda āā ℥j	Doctor visited; ordered milk and soda; patient to have 2 drops of croton oil on sugar; to have an enema of soap and water; dressings changed; abdomen very distended; gave hot glycerine per rect. ℥iij (retained)
	8.30	—	—	—	Passed mucus ℥iij; also flatus	—	—	Gave enema as directed; great quantity of flatus expelled
	9.0	—	—	—	—	—	—	Bowels acted well
	9.30	—	—	—	Bowels acted	Hyp. strych. ♏iij	—	Pain not so severe in abdomen; complains of sharp pain in the right side

SPECIMEN ENTRY—*continued*

Date.	Hour.	Pulse.	Temperature.	Respiration.	Bowels and Urine.	Medicine.	Nourishment.	Remarks.
1900. April 20 (2nd day) —*continued*	P.M. 9.35	140	102	32	—	—	Milk and soda āā ℥j	—
	10.0	140	102	32	—	—	—	Vomited clear fluid
	10.30	—	—	—	Bowels acted and flatus expelled	—	—	Patient very restless ; expelled flatus by mouth ; vomited clear fluid
	10.40	—	—	—	—	—	Milk and soda āā ℥ss.	Vomited milk and soda immediately
	11.0	—	—	—	—	—	—	Vomited green fluid
	11.15	—	—	—	Flatus expelled	—	—	—
	11.30	—	—	—	—	—	Milk and soda āā ℥ss.	Complains of great pain
	11.45	—	—	—	—	—	—	Doctor visited ; ordered morphine gr. ¼
April 21 (3rd day).	A.M. 12.45	—	—	—	—	Hyp. strych. ♏iij	—	Sleeping ; respiration quick and laboured
	2.0	144	101·4	36	—	—	—	Slept one hour
	2.10	—	—	—	—	—	Liq. peptonoids per rect. ℥ij (retained)	—
	2.40	—	—	—	—	—	—	Patient very quiet
	3.45	—	—	—	Urine passed ℥vj	Hyp. strych. ♏iij	—	Vomited bile-stained fluid ; hiccough very troublesome
	3.50	—	—	—	—	—	Soda and milk āā ℥ss.	—
	4.30	140	—	—	—	—	—	Vomited bile-stained fluid
	5.0	—	—	—	—	—	—	Vomited bile-stained fluid
	5.10	—	—	—	—	—	—	Sleeping.

	6.0	144	100	28	—	Hyp. strych. ♏iij	Liq. peptonoids and brandy per rect. ℥j (retained)	Slept twenty minutes; respiration slightly relieved, not so short and quick; left side very painful
	7.0	—	—	—	—	—	—	Vomited bile-stained fluid ℥iij
	7.40	—	—	—	—	—	—	Sleeping
	8.10	140	—	28	—	—	Soda and water by mouth ℥j	Slept fifteen minutes; tongue dry; very drowsy; vomited ℥j
	8.30	—	—	—	—	—	—	Vomited bile-stained fluid ℥v
	9.0	—	—	—	—	Hyp. strych. ♏iij	—	Expelled flatus by mouth
	9.15	—	—	—	—	—	Soda-water in sips	Slept fifteen minutes
	9.25	—	—	—	—	—	—	Vomited bile-stained fluid ℥v
	10.0	140	101·2	30	Passed urine (normal) ℥vj	—	—	Expelled flatus by mouth; vomited bile-stained fluid ℥vj
	10.30	—	—	—	—	—	Hot coffee ℥ss.	Doctor visited; ordered wash bowels out with 1 quart of hot water and soap, and add ℥ss. of Warburg's tincture to the nutrient enemata
	11.0	—	—	—	—	—	Hot coffee ℥ss.	Doctor removed dressings; applied hot boracic fomentations over abdomen; injected antitoxin to left of pubes; vomited coffee
	11.15	—	—	—	—	Injection of antitoxin ℥ss.	—	Gave enema, 1 quart of hot water and soap; water expelled discoloured
	P.M. 12.5	—	—	—	—	—	—	Vomited bile-stained fluid ℥v
	12.20	—	—	—	—	—	—	—
	1.0	—	—	—	—	Hyp. strych. ♏iij; injection of antitoxin ℥j	—	Injected antitoxin in right side of mons veneris
	1.30	—	—	—	Passed urine (normal) ℥viij	—	Liq. peptonoids per rect. ℥ij (retained)	Very restless; changed foment

SPECIMEN ENTRY—*continued*

Date.	Hour.	Pulse.	Temperature.	Respiration.	Bowels and Urine.	Medicine.	Nourishment.	Remarks.
1900. April 21 (3rd day) —*continued*	P.M. 2.0	144	101·2	30	Passed mucus ℥v	—	Black coffee (hot) ℥j	Vomited coffee and bile
	2.30	—	—	—	—	—	—	Vomited bile-stained fluid
	2.40	—	—	—	—	—	Warburg's tinct. and brandy per rect. ℥ss. (rejected)	Did not retain enema
	3.0	150	—	36	—	—	—	Pulse rapid; hands getting cold; changed foment; vomited bile-stained fluid
	3.30	150	103	36	—	Hyp. strych. ♏iij	—	—
	4.0	—	—	—	—	—	—	Changed foment; patient very restless; pulse weak and rapid
	4.15	—	—	—	—	—	—	Very restless; craving for drink; complaining of burning sensation in throat; tongue moist; vomited bile-stained fluid; applied mustard-leaf to stomach
24-48 hours' summary.		150 / 128	103 / 101	36 / 30	Urine ℥xxvj; bowels ℥ij	Antitoxin hyp. ℥jss.; morph. hyp. gr. ¼; strych. hyp. ♏xxj; Warburg ℥ss.	Milk and soda by mouth ℥iv; soda and brandy ℥ivss.; peptonoids by bowel ℥v	Patient is hopeless; all symptoms of peritonitis present.—Note by doctor

	5.0	—	—	—	—	—	Liq. peptonoids ʒij and Warburg's tinct. ʒss. per rect. (retained)	Vomited when turned on side; pulse very weak and rapid
	5.30	160	103·4	36	Expelled flatus	—	—	Feels very weak and faint; patient very restless; hands quite cold; pulse very weak; vomited bile-stained fluid; renewed foment; abdomen very distended; expelled flatus by mouth; vomited ʒj at short intervals
	6.0	160	103·4	36	—	Hyp. strych. ♏iij	—	—
	6.15	—	—	—	—	—	—	—
	7.0	—	—	—	Passed urine ʒv	—	—	—
	8.0	—	—	—	—	Antitoxin ʒj	—	Injected antitoxin in left side of mons veneris
	9.0	—	—	—	—	—	Liq. peptonoids per rect. ʒij (retained)	Gave enema of hot water and soap; expelled; vomited bile-stained fluid
	9.15	—	—	—	Enema expelled	Hyp. strych. ♏iij	—	—
	9.30	—	—	—	—	—	Brandy ʒij	Vomited dark fluid at intervals
	10.0	—	—	—	—	—	Warburg's tinct. per rect. ʒss. (retained)	Changed foment
	10.15	Rapid	—	—	—	—	—	Vomited dark fluid
	11.15	—	—	—	—	—	—	Transfused saline solution 1 pint under each breast
	11.30	—	—	—	—	—	—	—
	11.45	160	106	60	—	—	—	Very restless; changed foment
April 22 (4th day)	A.M. 12.0	—	—	—	—	—	—	Vomiting; skin bathed in perspiration
	12.10	—	—	—	—	Hyp. strych. ♏iij	—	—
	12.23	—	—	—	—	—	—	Expired

Clinical Charts.

The majority of surgeons will be quite content with a case-book in the form we have just described, and, in fact, in private operations anything further would be impossible. If, however, the surgeon be connected with a hospital where there is a house-surgeon who is bubbling with suppressed energy, he may adopt another plan, which is valuable, inasmuch as we are able to obtain a résumé of the chief points of the case in an almost graphic form; and if we are investigating any one symptom or group of symptoms, we can, by glancing at the charts about to be described, obtain the desired information with a minimum of trouble.

The plan adopted is to have a series of charts on which are recorded the most essential facts connected with the case. Frazier* has described those used at the University Hospital, Philadelphia, and they may be taken as an excellent illustration. Frazier uses five charts: (1) History and treatment record; (2) anæsthesia and operation record; (3) nurse's record; (4) temperature record; (5) pathological, bacteriological, blood, and urine record.

1. **History and Treatment Record.**—At the top of the sheet space is allowed for the filling in of a number of data that will be frequently referred to, and which if not isolated must be tediously searched for in the rest of the history. Thus the age and address of the patient, the name and address of the physician by whom the patient was referred, the diagnosis, the character and date of the operation, the character of ligature or of suture material used, the introduction and withdrawal of drainage-tube, the frequency of subsequent dressings, and the date at which the sutures were removed, are given. Then follow the history and examination of the case, the description of the operation, and the subsequent ward notes.

2. **Anæsthesia and Operative Record.**—Frazier thinks that these charts form the basis of valuable statistics, and they are of value in that they keep the attention of the anæsthetist constantly on his patient. The pulse, taken every ten minutes, is represented by a tracing upon the chart, and the rate of respiration is recorded below in numerals.

* *Annals of Surgery*, December, 1900

3. **Nurse's Record.**—This chart is drawn up very much after the style of the case-book that we have described.

4. **Temperature Record.**—This will show the date, pulse, respiration, and the temperature. The pulse in Frazier's chart is marked in numerals up the side of the chart, but we consider that a graphic record in red ink is a better plan, the temperature being indicated in black ink.

5. Upon one side of the last sheet is entered the **Pathological and Bacteriological Record** upon its receipt from the laboratory of the pathologist or bacteriologist to whom the specimen has been referred. On the back of the report is kept **a Blood and Urine Record,** the upper part of the chart being devoted to the blood, the lower part to the urine analysis.

CHAPTER XX

TREATMENT DURING THE FIRST WEEK AFTER THE OPERATION

THE operation being completed, the dressings are applied and the binder adjusted. The drawers are stripped from the patient if they have become wet or soiled, otherwise they may remain, while a fresh, warm flannel nightdress, made to open down the back, is slipped on just before the patient is lifted on to the trolley. All that now remains to be done is to transfer the patient to her room. If the institution possess a trolley, this is wheeled up alongside the operation-table, and if the patient is light, she is lifted up and placed on the trolley (Figs. 90, 91); but if she be heavy, it is much easier to lift her by the sheet on which she is lying. The trolley should be covered by a blanket; it should be so constructed that in cold weather it can carry reservoirs of hot water to warm it, for a patient who is suffering from shock bears the transport from the warm operation-room along cold corridors very badly. Everything, therefore, should be done to keep the patient warm during this period, and she should always be well covered with blankets. If there be no trolley, the patient can be carried on a stretcher formed by a piece of sail-cloth, 7 feet in length and 30 inches in width. This is slipped under the patient, and two stout poles are run into apartments which bound its longest sides. To carry the patient from one room to another in the arms of attendants or friends—a plan which has to be adopted in private houses—is not to be commended, and this plan is absolutely dangerous if the patient is wearing a glass drainage-tube.

On reaching the bedside, the patient should be lifted by the two ends of the sheet being seized, while a nurse stands on the side of the bed opposite to that on which the trolley is so as to slip her hands under the patient's buttocks, and thereby steady her descent.

FIG. 90.—Wheel Stretcher, with Hot-water Cans, used at Lewisham Hospital Sydney.

To face p. 184.

Should the patient be wearing a glass drainage-tube, we must take great care lest it become displaced, or even broken, during this period.

The patient being now placed on a bed which has been already warmed by a good supply of hot-water bottles, she is covered by two blankets, and hot-water bottles are placed at her feet, between her legs, and along her sides. Her head is kept low,* and if the operation has been a severe one the foot of the bed is raised from 6 to 18 inches.

We may not be able to procure rubber hot-water bags in

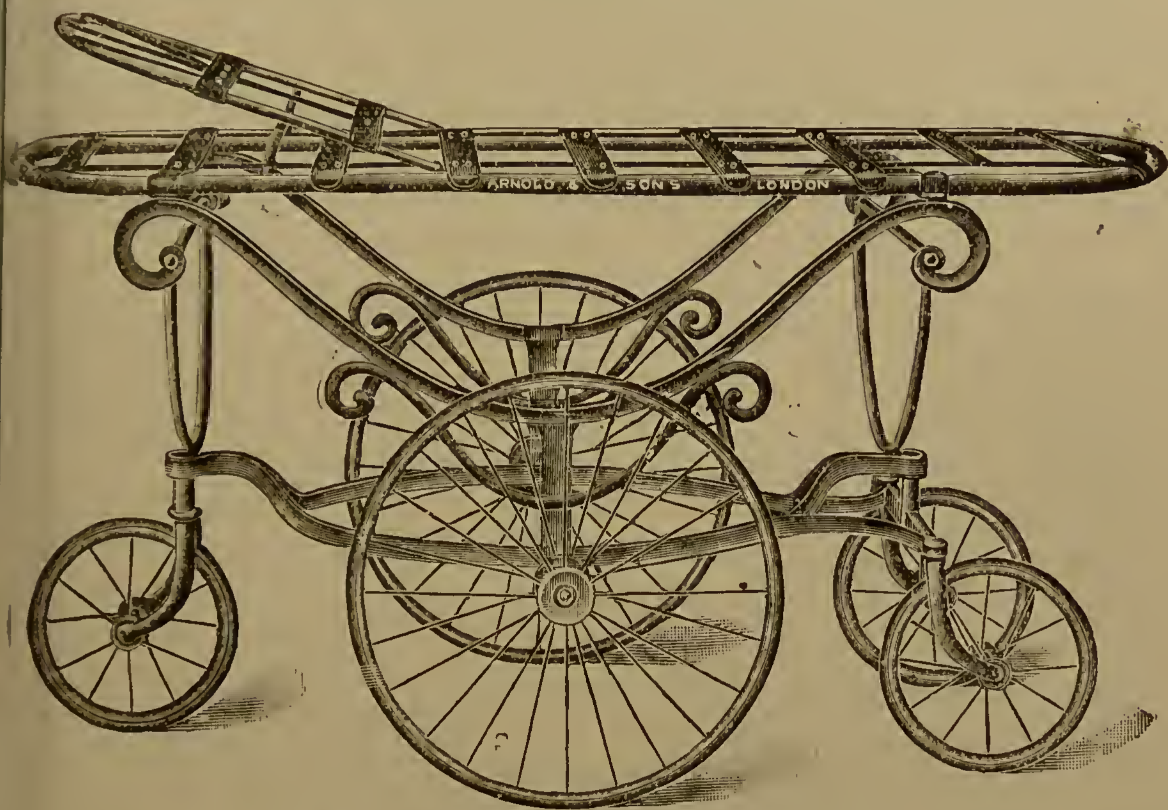

Fig. 91.—Wheel Stretcher (the top is detachable).

private houses; we must then fall back on hot bricks and stone bottles. We must be careful that the corks fit well, while bricks and rubber bags must be wrapped in at least three layers of blanket. To place a rubber bag unprotected by a blanket beneath the heels of a half-conscious patient is the most culpable piece of negligence a nurse can be guilty of. We have seen a patient burnt in this way so severely that she could not walk for three months after the operation, and then only with great pain. Having adjusted the bottles and tucked the blankets all round the patient, the nurse takes up her position by the bedside.

* Unless the patient have an enlarged thyroid.

As the patient 'comes to,' the nurse should observe the colour of her lips and her conjunctivæ, so as to be able to tell, when some hours have passed by, whether the patient is becoming more blanched from hæmorrhage.

As the patient regains consciousness, she will begin to strain, to retch, or to vomit, so the nurse should have at hand a shallow enamel basin, or one made of thick rubber, which can be bent and adjusted to the patient's jaw. A deep vessel is unsuitable.

If ether has been the anæsthetic administered, the patient may be so choked with mucus that she may become livid, and cause the nurse very considerable alarm. For this reason the anæsthetist or the surgeon should remain at the bedside until the patient is conscious, or, if not conscious, until her breathing is quite tranquil. If the face is cyanosed, the foot of the bed should not be raised until the patient's face is a better colour.

During the time the surgeon is waiting by the bedside, he should slip his hand beneath the blanket, and examine the patient's pulse at her wrist and in her neck.

If the pulse is weak, and there is shock present, he should inquire from the anæsthetist concerning the behaviour and the character of the pulse during the course of the operation, and ascertain if any strychnine has been administered; and he may then deem it necessary to order a hypodermic injection of strychnine, adrenalin, or digitalis, or he may order a submammary injection of saline solution, to which brandy may, if necessary, be added, or he may be content with an enema of carbonate of ammonia, liquid peptonoids, champagne, saline solution, or black coffee. In addition to these measures, some surgeons are accustomed to administer a small quantity of morphine or atropine at this time.

Nothing more is required to be done for the patient for the present, except in some cases to practise artificial respiration for a short period when the patient is suffering from the effects of a too prolonged narcosis.

Gradually the patient becomes conscious, but we have known instances when the patient remained quite unconscious for six hours after the operation, though she showed no signs of collapse. The nurse may help to restore consciousness by the very judicious use of the smelling-salts bottle, care being taken that the bottle does not contain any fluid, lest it should run out over the patient's face—a not uncommon accident.

As the patient regains her senses, she will begin to complain of her pains, and if she be a neurotic woman she may become almost unmanageable, and require more than one nurse to restrain her. During this period the nurse should never be absent from the bedside for a moment, for a patient in a semi-conscious state may rise from bed and escape from the room in which she is being nursed. Howard Kelly says: 'After one of my earliest abdominal hysteromyomectomies the patient, an old Irishwoman, got out of bed, and walked through two rooms and over a brick pavement to the closet in the yard. Another patient, a mulatto girl, who had an extensive suppurative peritonitis, persisted in getting out of bed and lying upon the floor, never having slept in a bed in her life before.' Both of these cases recovered!

When the patient begins to recognise her surroundings, she soon asks for a drink, for her mouth feels parched, and her thirst has commenced already. Finding that she cannot have a drink, she soon finds fault with the tightness of the binder, and wants it loosened; and then, after a few hours more, when her mouth is very parched, when the pain from the pedicle is acute, and the vomiting helps to complete her misery, she breaks out in lamentations, and bewails the day that she ever had the operation performed.*

It is generally about this period that the surgeon returns to visit his patient, and if he be inexperienced or tender-hearted the evident misery of his patient may induce him to order her some morphine, but to do so is often—very often, indeed—a mistake, and the surgeon recognises that fact next day.

But is the surgeon to leave his patient to go through that awful first night of misery without attempting to relieve her suffering? We are forced to admit that, while we may make the attempt to relieve her, the result is generally a failure. We can give nothing by the mouth that will be of any use, for the patient can seldom keep anything down; hypodermically, no drug is available, though we may get a good result from hyoscine hydrobromide ($\frac{1}{150}$ grain) when the patient is strong and very excitable; by the bowel we may try bromides, chloral, chloralamide,

* If the patient has been suckling her baby, as in cases where ovarian tumours are operated on soon after labour is completed, the baby may be put to the breast twenty-four hours or sooner after the operation (August Martin, *British Gynæcological Journal*, November, 1898).

sulphonal, and find that we have tried in vain. Trional, however, may come to our aid most effectually at times, especially when we employ morphine ($\frac{1}{8}$ grain) hypodermically, and give bromide with the trional.

The young surgeon is not to be disheartened at his failure to relieve his patient's sufferings; he fails here, but so do the experienced.

But if the surgeon cannot relieve his patient's misery, he can at this first visit direct the nurse's attention to important points to be observed during the night that will help to tide the patient over her first dangers, and tend to make her more comfortable.

The surgeon at his first visit—during the evening of the first day—will proceed as follows:

On entering the room, he should notice the temperature and observe the ventilation. On approaching the bedside, he will note any marked alteration in the patient since his last visit. After speaking to the patient for a short time, he should feel her radial and carotid pulse and ascertain the temperature. He should also glance at her tongue, so as to be able to appreciate any alteration that takes place during the next few days. He should next lay his hand on the patient's forehead, for if he finds that quite warm, he may satisfy himself that she is not suffering from secondary hæmorrhage or shock. If, however, there has been considerable bleeding since his last visit, he will note the increased pallor of the conjunctivæ and lips.

There is no need to examine the abdomen at this visit, nor to disturb the bandage unless we are using a drain, and anticipate hæmorrhage.

The surgeon must be prepared to listen to the patient's tale of woe, and if she does not complain of her pains she will always beg for a drink. The surgeon should explain to her that it is impossible to let her have draughts of cold water, or to allow her to suck ice, and he can generally make an honourable retreat by promising her sips of hot water.

He should inquire as to her comfort, and he should never turn a deaf ear to a sensible woman's complaints. If she says that the bedclothes are too heavy, or that she is too warm, or that the room is oppressive, he should see to these matters; such complaints are often treated by nurses as 'mere fads' or 'hysteria.' We have usually found that such complaints made by sensible patients are well founded.

Turning now from the patient, the surgeon seats himself at the nurse's table, and runs his eye over her notes. He then writes out under various headings his instructions for the night, directing the nurse to be on the watch for any complication that he may reasonably expect. If the nurse was not present at the operation, then the surgeon should give her an idea of what was done, so as to make her *au fait* with the actual condition that the patient is in.

Left alone with her patient, the nurse will endeavour to add to her comfort by placing a pillow under her flexed knees, by turning her first to one side, then to the other, or by placing a very small cushion or pillow first in one situation and then in another, just to humour the fancy of the patient. She should sponge the patient's face and hands with hot or with cold water, and she should allow her to rinse her mouth, or to have the sips of warm water sanctioned by the surgeon, taking care not to use a metal spoon, or the patient's lips and tongue will soon be made tender; a wooden spoon is much better.

At midnight many surgeons order the first cathartic to be administered; this usually consists of calomel, while others prefer to begin with teaspoonful doses of magnesia—a line of treatment which sometimes starts the patient vomiting for the remainder of the night. We prefer to administer a capsule of calomel (3 grains) and pulv. elaterii co. (2 grains), and if this be vomited the patient is not given anything else for four or five hours.

From midnight on till four o'clock is often a very critical time, and the nurse, who from time to time has probably been administering nutrient enemata, will frequently be called upon about this period to give the patient a pint of normal saline by the bowel; and in some cases she may have to resort to the submammary transfusion, to place an extra blanket on the patient and to inject strychnine, digitalis, and adrenalin.

Usually, if all be going well, the temperature and pulse are between normal and 100 at this time; but if the case is taking a 'bad turn,' the pulse begins to grow rapid and weak, and the temperature may sink below normal. The nurse should, under such circumstances, always keep the patient's head low, and raise the foot of the bed.

As the morning of the second day approaches, the patient, wearied out, falls into an unrestful doze, only to wake to

complain of the flatulence which now adds fresh misery to her accumulated troubles. She may be able to belch a little wind up and pass a little from the rectum, and the nurse endeavours to aid her by passing the rectal tube, administering an enema of soap, turpentine, and hot water, or one of quinine and whisky, or of alum and warm water.

If the patient has had a good night, and there has been little vomiting, the nurse may now begin to give tablespoonfuls of milk mixed with plain water, Vichy, soda, or lime water. If the patient retains this, the same quantity may be given every hour; but if the patient vomits, *everything by mouth should at once be stopped for two or three hours.* If the patient is weak the rectal feeding may be continued, peptonized milk with eggs, or Carnrick's liquid peptonoids and saline, being administered every four hours. At seven o'clock the nurse should attend to the patient's toilet; the face should be sponged, the mouth rinsed with warm water, the hair attended to, the arms and hands sponged with warm water and alcohol, and the nightdress and draw-sheet changed. If the patient has not passed water, it may now be drawn off and measured, and a note made of the quantity in the notebook, and a portion put aside for the surgeon's inspection.

Having attended to the patient, the nurse should now turn her attention to the room itself, after which she should enter up her notes and dot in her temperature and pulse charts, so as to have everything ready for the nurse who relieves her, and for the surgeon's early visit.

If the patient has had a good night, and everything is progressing favourably, the surgeon need not pay an early morning visit; but if the case has been a serious one, and the telephone report is unfavourable, he should see his patient between seven and eight in the morning of the second day.

At his second visit the surgeon will go through the same routine as he observed at his first visit. He notes the pulse and temperature, examines the tongue, runs his finger over it to note its dryness, and then proceeds to question the patient. She will, as during his first visit, complain of thirst; but now her chief trouble will probably be the colicky pains from the intestinal gases. Australian women almost invariably beg to be allowed to have a cup of tea; others are content with the promise of cold milk.

The bedclothes at this visit should be turned down, and the

abdomen gently percussed through the binder. If it is evident that there is very little distension the binder need not be disturbed until the patient complains of its tightness. If, however, there is evidence of distension, the binder and dressings should be removed, and the abdomen should be inspected, palpated, and percussed, and if a glass tube is being employed the sucker should be introduced by the nurse, so that the character of the fluid withdrawn may be ascertained. If the tube is to be left in, the surgeon should direct the nurse to turn it round, so that he can satisfy himself that the omentum is not herniating itself into the perforations in its sides.

Fresh dressings and a clean binder having been placed in position, the surgeon now turns to the temperature and pulse charts, and he then reads through the nurse's notes, adding any remarks and sketches that he may wish to make, and setting down the treatment to be adopted during the course of the day.

It is a good plan at this visit, while the details of the operation are still vivid, to write a short account of it, and to add a rough sketch; for such drawings, no matter how crude they may be, will often, after years have elapsed, bring back to one's memory the difficulties of an operation much more vividly than many pages of notes.

Before leaving the hospital the urine should be tested. If the quantity passed has been very small, a couple of drachms of acetate of potash may be ordered to be administered with the next enema of saline solution, or with the next nutrient enema.

If no urine has been secreted, then the surgeon will be called upon to decide whether he has to deal with anuria due to shock or hæmorrhage, tied or knotted ureters, or nephritis. If the urine contains blood, he should inquire if there is hæmorrhage from the vagina, for this may have contaminated the urine, and will account for a trace of albumin.

As the second day progresses the temperature and pulse usually increase, occasionally to an alarming extent, even in patients who recover without any obvious complication.

If the bowels act during this day the tympanites is not marked; but, as a rule, although the patient may expel the gas freely from the bowel, she will complain of the colicky pains due to the intestinal gases. Probably the chief discomfort that follows a section arises from meteorism, for the first pains that a patient complains of, due to the ligatured pedicles, begin to die

away after eighteen hours; but the pains due to tympanites increase at this period. Of all the remedies that we can try, not one equals an enema of soap and water with a tablespoonful of turpentine, and when this fails we may fall back on an injection of alum and water, sulphate of magnesia, and glycerine, quinine, and whisky, or the enema asafœtidæ.

One of the most distressing events of the second day (eighteen to twenty-four hours) is continued vomiting. The patient can take nothing by the mouth, she is parched with thirst, and each time she retches or vomits she suffers great tortures from the sutures of the abdominal wound. Innumerable have been the remedies that have been suggested to relieve her, but some of the simple ones are often most efficacious, and a cup of black coffee is one that should always be tried. A mustard-leaf on the epigastrium is not to be despised, while a capsule containing bismuth salicylate, calomel, and Dover's powder has long been successful in our hands. It is in these cases that a spoonful of ice-cream is most grateful to the patient, and she relishes it because she is so parched with thirst. In continued vomiting always endeavour to obtain an action of the bowels; this is often the keynote of success.

After noon has passed (twenty hours) we not uncommonly encounter a characteristic train of symptoms in cases where there has been a prolonged operation and the pulse has not fallen below 110 since the patient left the table. Such patients usually have a bad first night, and require a saline injection about 3 a.m. (twelve hours), as the pulse grows very weak and thready, and may run up to 140. As the morning approaches they become somewhat better, and in the afternoon the pulse begins to increase again, until by four or six o'clock (twenty-four hours) it may be 160. These are the cases which we have described as examples of 'continued shock,' and they require to have a liberal allowance of digitalis, strychnine, adrenalin, and saline injections, though it is to be noted that transfusion in some instances not only does no good, but actually seems to hasten the patient into the grave.

Late in the afternoon (twenty-six hours), or during the evening of the second day, the surgeon will visit his patient. This visit is a very important one, for we may often even thus early detect the coming storm. Not only must the pulse, the temperature, and the tongue be examined, but we must carefully study the

patient's countenance and her attitude ; in fact, the *tout ensemble* is to be placed side by side with any single and ominous factor.

Face to face with trouble, the surgeon will bear in mind that during the first twenty-four hours the chief dangers encountered are shock and hæmorrhage, while only quite rarely has he to deal with fulminating peritonitis, marked septic intoxication, nephritis, and injuries to the ureter and bladder. It is quite useless for him to conjure up rare complications, for shock, hæmorrhage, and commencing peritonitis are a trinity which are quite sufficient in themselves to test the skill of most surgeons.

We have dealt with the subject of 'continued shock'; the treatment of commencing peritonitis is summed up in one word, 'purgation.' The surgeon is left to decide now whether he is face to face with secondary hæmorrhage. This is certainly one of the most painful moments in the life of a young surgeon, when, after having informed the patient's friends of the result of the operation, after priding himself on his success for twenty-four hours, he stands by the bedside perplexed, while he tries to arrive at a definite conclusion. He sees his patient weak and exhausted, with a thready pulse, and he knows that if hæmorrhage be the cause of her condition, reopening is her only chance; while, on the other hand, if hæmorrhage be not the cause, then his untimely interference will probably turn the balance against her. It is at such a moment that the help of an experienced colleague is of infinite value; but the surgeon should never shirk the task of endeavouring to decide a difficulty for himself. He should calmly seat himself by the patient's bedside, and watch and study her until her actual condition grows gradually more and more clear in his mind. To arrive at a conclusion by one's self thus unaided is a victory of infinite value to the surgeon.

Before leaving the room the surgeon will again carefully write his instructions for the night. If all has gone well up to this point, if the bowels have acted, and the distension is not marked, the surgeon may well consider how he will best obtain a good night's rest for his patient, and it is at this time that we think a small injection of morphine ($\frac{1}{8}$ grain) and a dose of trional by mouth may be of infinite value to a woman who has not slept since the operation. On the other hand, if we see indications of coming trouble—a rising temperature, a bounding pulse, a dry, clean tongue, and tympanites, we should shun morphine,

and regard it as little better than a curse. We may, however, try bromide by the bowel and trional by mouth; these drugs, if they do not produce sleep, will often cause the patient to have some hours rest and quiet.

In reading the reports of cases for the second night (thirty to forty hours), we see at once the difference between the patients who are progressing favourably and those who are getting into trouble. In the reports of the first we see: 'Patient slept at intervals, did not vomit, retained fluids by mouth, and expelled flatus freely; she had five hours' sleep during the night.' The reports of the second say: Patient restless, slept twenty minutes, vomited bile-stained fluid (2 ounces), bowels acted slightly, quantity of flatus expelled, very thirsty, tongue dry, complains of pain in abdomen and back, flatus troublesome, gave turpentine enema, flatus expelled, patient much exhausted, vomited brandy, etc.'

The one report shows the patient in comparative comfort, having sleep which lasts for an hour or more at a time; she is ready to take her nourishment, and does not vomit, and the flatus does not trouble her much; the other patient sleeps only in snatches of fifteen to twenty minutes, then wakes with a parched tongue and craves for a drink, then rests for a time, then vomits a bile-stained acid fluid. Exhausted with her efforts, she is quiet for a time, until the flatus disturbs her. She tries to expel it, but cannot; the nurse passes the rectal tube, and this causes her pain, for the rectum is sore and tender with the enemata she has had, and thus hour after hour her misery goes on.

When the surgeon visits his patient on the morning of the third day (forty hours), he will usually be able to settle the prognosis.

The report from the nurse when the patient is going on well, combined with the aspect of the patient and the curves of the pulse and temperature charts, all tell the experienced man very definitely when all is well; on the contrary, when the patient is developing septic trouble, the history of the previous night, the change in the colour of the patient's face, the tongue, the pulse, the temperature, the tympanites, the absolute condition of unhappiness of the patient, all strike one at once. If the pulse is not bounding it is rapid, and as noon approaches it invariably changes for the worse, and if the case is getting

hopeless, the pulse will always be very rapid and very small; if the sepsis is not virulent, the pulse will remain full and bounding. If the tongue is moist and the pulse slow there is usually little immediate danger; if the tongue is clean, glazed, and dry, and the pulse rapid and small, the patient is in peril.

On the morning of the third day the surgeon, in thinking of complications, will, of course, give the first place to peritonitis. He may cast shock and hæmorrhage aside; he may think of septicæmia, ileus, pseudo-ileus, gangrene of the bowels, chest complications and renal trouble, gastric hæmorrhages, and emphysema of the abdominal walls.

When it becomes obvious that the patient is suffering from peritonitis, the surgeon will inevitably fall back on that line of treatment which appears to give the patient the best chance according to our present state of knowledge—that is, he will endeavour to keep the patient's bowels acting.

We need not pause here to ask why purgation does good in cases of peritonitis in the early stages; a universal experience has proclaimed that fact. That purgation can benefit a patient suffering from severe septic peritonitis is doubtful, because the patient is being overcome by an absorbed poison, over which purgation has little control. And what is said of purgation may be said of all our other remedies; we, in the face of this complication, do everything in our power, but what that amounts to is practically nothing. The question will present itself to the surgeon whether he will reopen his patient, wash her out, and give her a last chance, and this step is one that may be rewarded with brilliant success. Not, however, till we can cope with the absorbed poison can we hope to deal with this complication with any success.

We shall not pause here to consider the complications that the patient may suffer from during the first week; we shall merely sketch the progress of an uncomplicated case.

During the third day the patient will be able to take some milk and soda, some beef-tea, some cold chicken jelly, and a little brandy and water. On the following days she may have some Benger's food, oyster broth, jelly, and junket, and by the sixth day she may be given an egg, and after this day a little chicken, brains, and tripe.

It is well not to allow the patient to have any vegetables until

the tenth day, though she may have a little ripe fruit before that time.

On the fourth day, if the patient complains, the surgeon should inspect the stitches, and if there be a halo of redness about any of them, they should be inspected every day.

On the fourth day, if we are employing an iodoform drain, this may be removed, if we have not done so already. It is well to administer a little chloroform when we are removing the gauze through the abdominal incision, but this is hardly necessary

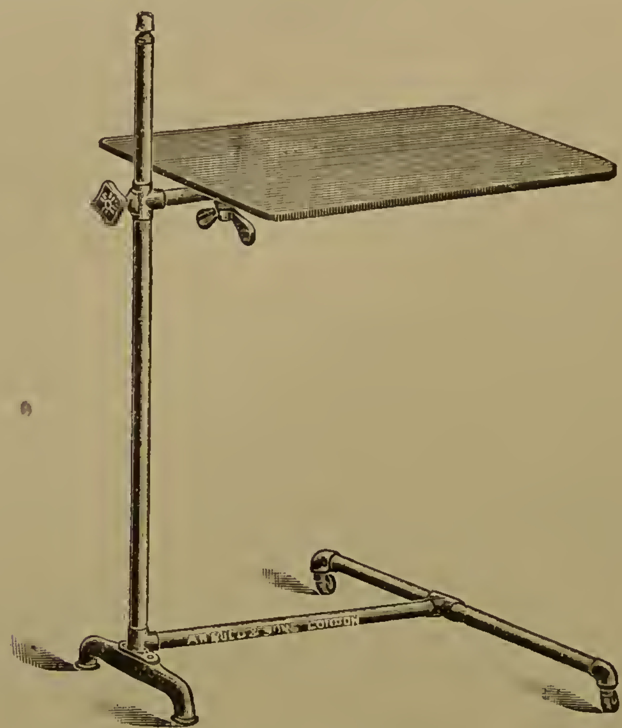

FIG. 92.—Bed-Table.

when we are removing the gauze by way of the vagina, as it does not occasion the patient nearly so much pain.

The patient is now fit to be moved back to the general ward if she is in a hospital.

A stitch abscess, or a suppurating wound, may cause her some distress, but the majority of cases have little further trouble.

If the wound has been closed with through and through sutures of silk-worm gut, these may be left in until the fourteenth day, unless a stitch abscess develops, when the suture must be removed.

After removing the sutures we always place some strips of

FIG. 93.—The Alice Lamb Belt.

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Mead's plaister across the wound. These strips serve to support the newly-generated tissues, and also keeps a strip of dry gauze, which covers the incision, in position.

The patient is allowed to leave the bed on the seventeenth day; if, however, she feels weak, she may be merely propped up in bed to have her meals. A bed-table (Fig. 92) will be now found useful.

Our patients are always fitted with an abdominal belt before leaving the hospital. It has become the fashion to discard these belts, and to look upon them as of little real help. We believe they serve two useful purposes: they help to prevent the stretching of the newly-formed tissues that bind the sides of the incision together, and they serve to remind the patient that she has a weak spot in the abdominal wall, and this prevents her attempting to lift heavy weights or strain herself.

If the incision has been closed with buried sutures of silver

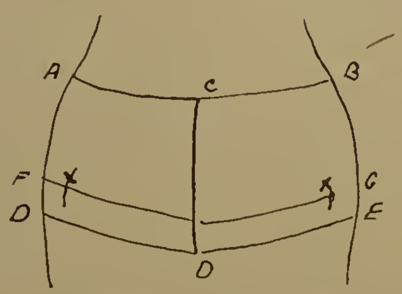

FIG. 94.—Diagram for Belt Measurements.

wire or of any other unabsorbable material, a belt is not so requisite; but we are utterly opposed to patients being allowed to go without a belt simply because they have had the wound closed with layers of absorbable sutures. At the end of three weeks' time these absorbable sutures have disappeared, and the patient is in the same condition as one who has had the incision closed with through and through sutures.

We have tried many forms of belts, and the one that we now find most satisfactory has been evolved by the ingenuity of Miss Alice Lamb, the surgical belt maker to the Lewisham Hospital.

The accompanying illustration shows the belt recommended (Fig. 93).

In order to measure a patient for such a belt, three measurements should be taken, as shown in the diagram.

The first measurement (Fig. 94, A to B) that is made is the

circumference of the body at a point just below the navel, and from this point to the pubic bones (C to D), which is about 6 or 7 inches ; if, however, the woman is very small, the depth may be only 5 inches, while in stout women the measurement may be 12 inches.

The next measurement is taken round the great trochanters (F to G), and 1 inch below this again (D to E). In taking the measurement over the trochanters a point is noted in front, about 1 inch internal to the trochanter, as shown in the diagram. The object of this measurement is to fix the point where the elastic is to be inserted in the belt, for were the bones of the belt allowed to come in contact with the upper part of the femur, the wearer would be very uncomfortable.

CHAPTER XXI

VOMITING—NAUSEA—HICCOUGH

Vomiting.

Few patients take an anæsthetic for any considerable period without vomiting afterwards. There are, however, some patients who never vomit, but they suffer from nausea, and they long to vomit in the hope that they may get relief.

There are many women who vomit incessantly after the anæsthetic; these patients in health are generally 'bad sailors,' and a sight, a tale, a smell, a thought, will cause them to vomit. These women are bad subjects for a section, for the continual and protracted vomiting increases the irritability of the mucous membrane and of the nerves of the stomach, while the action of the heart is reduced in force from depression of the cardiac and vascular centres, and prostration follows from the lowering of the motor centres of the brain. The constant straining gives the patient great pain from the tension on the sutures in the abdominal wound, and these have been known to give way suddenly, and through the ruptured wound the intestines have escaped into the bed. Even if the abdominal wound do not open, the straining may force the edges of the fascia asunder, and so lay the foundation for an incisional hernia.

Again, the ligatures of the pedicle may be loosened, and secondary hæmorrhage set in, or we may have increased oozing from capillary vessels. Olshausen remarks that vomiting may prevent the encapsulation of deleterious substances which have entered the abdominal cavity, and vomiting may favour their diffusion in the peritoneal cavity.

Since vomiting is but a symptom, we must, in considering its import, note the time when it sets in, its duration, and the character of the vomited matter.

The anæsthetic is responsible for much of the sickness of the

first twenty-four hours, and we think that chloroform causes more sickness than ether; while both Spencer Wells and Olshausen found that vomiting is much less frequent after the administration of methyl bichloride. We have also noticed that vomiting is less if morphine and atropine have been administered previous to the operation. Chloretone also lessens post-operative vomiting, but causes nausea, and we have found that those patients who have had an anæsthetic on a previous occasion much preferred the vomiting to the nausea.

We are positive that chronic dyspeptics vomit more than those women who smilingly tell you that they can drink eight cups of tea per diem without the slightest inconvenience.

Women who are accustomed to 'nip' vomit more than temperate females, while the hardy country woman vomits less than the bilious or the hysterical city woman.

The constriction of the pedicle, the pressure of a glass drainage-tube on the rectum, or the presence of iodoform gauze in Douglas's pouch, will all cause at times reflex vomiting.

In operating in private houses, the injudicious kindness of friends who supply the patient with forbidden diet, 'to keep up her strength,' is often the cause of serious vomiting. Tait operated once at a patient's house, and her friends fed her on biscuits and port wine, the result being that she vomited continuously for twelve days, and both recti muscles sloughed away.

The employment of strong soups and beef essences is a very common cause for vomiting at the present day.

Since surgeons have ceased to employ morphine extensively after their sections, and have taken to early purgation, nausea and vomiting have become less marked features in the after-treatment than they were in former days.

While vomiting during the first few days may usually be set down to the anæsthetic, we must never lose sight of the fact that it may be the early manifestation of peritonitis, uræmia, pneumonia, or intestinal obstruction. The stomach, as Ewald remarks, is the centre of a nervous plexus, whose branches have very wide connections, and directly or indirectly involve nearly every organ in the body; hence an irritation that occurs at any point in the plexus will reach the stomach, and vomiting may be the result.

The character of the vomited matter may tell us much, and

Tait laid it down as a rule that all vomited matter should be kept until the surgeon had inspected it; he said: 'This is a rule for my nurses of which I permit no breach.' We may modify this rule by instructing the nurse to save the vomited matter during the first twenty-four hours if it should contain blood, or should be dark in colour, like coffee-grounds; while if the patient continues to vomit on the second and third days, then the nurse should keep a specimen of the vomited matter from time to time; for these various specimens will show—as, for instance, in the case of peritonitis—a transition from yellow to emerald green and then to olive green, while as the case becomes more hopeless it becomes brown, like beef-tea, and then black, like coffee-grounds; it is never fæcal.

In cases of intestinal obstruction the amount of fluid vomited should be noted; thus, the quantity in ileus is always greater than in peritonitis. It not uncommonly is stercoraceous.

Lastly, we should note the character of the vomiting—that is, whether it is persistent or not. A patient may vomit for the first day, then begin to take food, and as she keeps this down the amount is increased; then suddenly, after twelve hours, she vomits up a pint of ill-smelling fluid, mixed with bile—little, if any, has been absorbed. When this occurs, the patient feels better, and then progresses well. But when a case vomits 'little and often' after the first thirty-six hours, we must be anxious. Treves says, in speaking of cases with peritonitis: 'In a very large proportion of cases which are carefully treated the patient will merely bring up a mouthful of fluid now and then. This is often accompanied with little effort, and many hours may elapse between the successive attacks. What is alarming and distressing in this slight degree of sickness are its persistence and the evil prognosis it suggests. The patient may be apparently improving, but there remains this periodical rejection of an ounce or so of fluid, which shows that the improvement is entirely delusive.' These remarks will apply to post-operative cases, and no sound can be more distressing to the surgeon's ear, on the third or fourth day, than that of hiccough when followed by the expulsion of a mouthful of bile-stained fluid; these are fatal signs. When, however, hiccough occurs during the first day, it may be due to the anæsthetic if ether has been employed.

Treatment.—As soon as the patient begins to regain consciousness she may vomit.

If ether has been administered, the vomiting will be of considerable benefit, as it tends to clear and empty the throat of an accumulation of frothy mucus that collects about the upper opening of the larynx, and if this be not removed it becomes churned up and down, and prevents the proper supply of oxygen entering the lungs, which is a serious matter when shock is present.

The nurse should turn the patient's head to one side, allow her to vomit into a very shallow basin, a soap-dish, or on to a towel, the head being only slightly raised. A basin made of soft rubber, whose sides can be depressed so as to fit under the jaw, is of great utility, and enables the patient to vomit with greater ease than when an enamel basin is employed.

If the patient's face remains cyanosed, and we know that the mucus is still lodged in the throat, a gag may be inserted between the patient's teeth and the throat swabbed out; this in itself usually excites emesis, and empties the stomach of bile and the throat of mucus.

Little or nothing can be done, or need be done, for the vomiting that takes place during the first three or four hours. We cannot stop it and we cannot prevent it.

We have frequently seen vinegar inhalation tried, but have not seen very marked benefit from it; this is probably because we have not had sufficient experience in its employment. Others, however, praise it, and Mackenrodt employs it extensively and with success. Lewin believes that its beneficent action is due to the neutralization of the free chlorine by the acetic acid. Since, however, some surgeons have had good results with it after employing ether, the simplest explanation is that it acts by stimulating the respiratory mucous membrane, and soothes the peripheral nerves, and lessens the irritability of the pneumogastric or its centres, and the reflex condition of vomiting is controlled.

After three or four hours we may give the patient sips of hot water, or hot water with a little bicarbonate of soda, which help to soothe the stomach. Vichy water is also agreeable and useful.

If she strain very much, the nurse should place her hand on the abdomen to steady it, and if the operator has inserted a glass drainage-tube, the nurse must take care that the straining does not displace this tube. She must also make sure that the

tube is not pressed down tightly on the rectum, or this in itself will cause reflex vomiting.

If the vomiting continues, the patient should be turned over on to her side, for it is much easier for her to vomit whilst on her side than while lying on her back. So long as the vomiting is constant and violent, the nurse should not attempt to administer any enemata, as the patient will only pass the fluid spasmodically, and the presence of the fluid in the bowel often increases the emesis.

As the hours of the first night pass by the emesis gradually ceases, and the patient's quiet is only interrupted by an occasional fit of retching or vomiting.

These are not the cases that give us trouble; the patients that we have to call all our therapeutic armament to bear upon are those in which the vomiting, instead of decreasing, continues until the patient is exhausted, her pulse is weak and small, and the skin from her mouth to her chin is red and excoriated from the stream of vomited fluid.

With such a patient we always try the effect of a mustard-leaf on the epigastrium, the administration of $\frac{1}{8}$ grain of morphine, and a cup of black coffee by the mouth. Some surgeons put 10 grains of sodium bromide in the coffee to increase its effect.

Teaspoonfuls of ice-cream we have found to act well when other things could not be retained.

We usually administer a capsule containing salicylate of bismuth (10 grains), calomel ($\frac{1}{12}$ grain), Dover's powder ($\frac{1}{4}$ grain), and we have had better results from this than from anything else we have tried.

Although rectal injections may cause the patient to vomit incessantly, nevertheless, we should give an occasional nutrient enema if the patient is growing weak; but nothing in the shape of food should be given by the mouth, for keeping an empty stomach is the surest way of lessening emesis.

With regard to the drugs that have been employed by surgeons after section cases, their name is legion. We have tried some of the following:

Acetanilide (1 grain), citrate of caffeine (1 grain).

Camphor monobromide, 1 grain every hour for six hours.

Cerium oxalate, 5 to 10 grains.

Cocaine, $\frac{1}{30}$ grain every half-hour.

Capsicum, 2 to 3 drops of the tincture in water.

Chloroform, 1 minim in a teaspoonful of water when ether has been the anæsthetic.

Carbonate water, such as Vichy, when the stomach is acid.

Creasote, 1 minim, every three hours. Creasote, $\frac{1}{4}$ minim in a teaspoonful of lime-water.

Carbolic acid, $\frac{1}{8}$ grain every hour.

Cheron's Effervescent Mixtures:

℞	Potassii bicarb. } Potassi bromidi }	āā grs. xxxij.
	Aquæ	fl. ℥ij.
	Misce.	
℞	Acidi citrici	ʒj.
	Syrupi	fl. ℥j.
	Aquæ	fl. ℥iv.
	Misce.	

A dessertspoonful of the former is added to a tablespoonful of the latter, and given every hour.

Fowler's solution, 1 minim in water every half-hour.

Hydrocyanic acid, 2 to 6 minims in water.

Ipecacuanha wine 1 minim in water every fifteen minutes.

Nux vomica, $\frac{1}{2}$ to 1 minim every half-hour in a teaspoonful of cinnamon-water.

Iodine tincture (1 minim) with carbolic acid (1 minim) in a dessertspoonful of water.

Tait at one time was accustomed to give Mason's pepsin wine in teaspoonful doses with a little ice-water every ten minutes, while Godell had good results with pepsin in 2-grain doses in a tablespoonful of raw beef-juice. Others speak well of phenocol in small doses, iced champagne, and brandy in cracked ice. An ice-bag or a hot-water bag applied to the epigastrium may be tried at times, and both have succeeded when other measures have failed.

Lastly, if we fail to relieve the vomiting we should resort to lavage* of the stomach, and we should do so before the patient becomes exhausted.

We may in the first instance give the patient a teacupful of warm water, in which we have placed a teaspoonful of bicarbonate

* Lavage of the stomach will most often be necessary after emergency operations, also in cases where acute gastrectasia occurs.

of soda, or we may give her a cupful of warm milk. Either of these will usually be followed by emesis, and the patient may be so relieved that she will not vomit for hours.

When this simple plan does not succeed, we may proceed to lavage by means of a rubber tube.

It is not necessary to describe the steps in this procedure beyond remarking that two things make the procedure easy of execution. The first is that the throat should be painted or sprayed with a 2 per cent. solution of cocaine, and the second is that when the tube is being swallowed and the patient is endeavouring to vomit, she should be told to take a deep inspiration through her nose. This simple device almost always prevents the tube being expelled.

When the lavage is finished, 1 drachm of subnitrate of bismuth suspended in 2 or 3 ounces of water may be poured into the stomach and left there.

Should the patient be troubled with hiccough during the first few days, this may be relieved by placing a spoon on the tongue as far back as possible, and holding it there for several minutes. A teaspoonful of sp. ætheris co. is often very effectual in giving relief.

Acid. acet. dil., about 1 drachm in 1 ounce of water, is very effectual in hiccough.

CHAPTER XXII

FOOD

Diet during the First Twenty-four Hours.

It may be laid down as a rule that no patient should have any nourishment **by mouth** for fourteen hours after a section.

It is extremely unwise to begin to give food by mouth before this time, for if the patient is in a serious condition from shock or hæmorrhage, it will be useless to expect absorption to any extent from the stomach; while if the patient is strong, food will not be necessary, and will probably only be a source of annoyance to her, as she will be feeling nauseated from the anæsthetic.

If all is going well, the patient may be allowed dessert-spoonfuls of hot water after four or six hours have elapsed; and after the fourteenth hour we may try her with milk and Vichy water, barley-water, or soda-water every hour. If, however, she vomits, then all fluid by mouth is withheld for two hours, when we may again try her with Semmola's glycerine drink,* or with Vichy water, which, of all fluids, we have found to be the most easily retained.

Before ordering milk for a patient, it is always well to ask her if it agrees with her when she is well. There are some women who cannot take milk without feeling sick, and who cannot digest it. This is often an inherited idiosyncrasy, which depends probably, as J. Hutchinson has pointed out, upon the constitution of the gastric juice, which in turn is due to some peculiarity in the glandular apparatus of the stomach. To force such patients to take milk will mean that they will either vomit it or the curds will pass into the bowels, and then lead to the production of large quantities of gas.

* *Vide* 'Thirst' for formula.

Instead of giving milk and water we may give peptonized milk by the mouth. Patients, however, seldom relish this, though it may be made palatable by flavouring it with coffee.

If we decide not to give milk, then we may begin with spoonfuls of hot beef-tea, cold chicken-jelly, or Carnrick's liquid peptonoids, always, however, observing the rule that if at any time the patient vomits we should give nothing more for two hours.

From the fourteenth to the twenty-fourth hour she is fed in this simple manner. Probably little of the nourishment is absorbed, but the fluid is grateful to the patient, and helps to satisfy her thirst. It is a sad error to suppose that because the patient is not vomiting this is an indication for increasing the quantity of nourishment during the first twenty-four hours. If we fall into this error, we shall find that the patient sooner or later will suddenly vomit the greater part of the food that we have fondly imagined has been absorbed, but which in reality has been lying in the stomach, serving only to dilate it and to create gas. We are particularly opposed to giving concentrated beef essences and beef-tea of that type 'which is quite a jelly when cold and in which a spoon will stand upright' at any time during the first week.

While the above is an outline of the method of feeding a patient during the first twenty-four hours when she is progressing favourably, yet it will not infrequently be found that constant vomiting will prevent many women taking anything for thirty-six hours but an occasional spoonful of Vichy or hot water. In such cases we must direct our attention to rectal feeding, for to attempt to feed such patients by the mouth will not only increase the vomiting, and instead of supporting the patient's strength we only help to exhaust her.

'In the abstract it is desirable that the patient's strength be maintained, but this is not effected by introducing food into a stomach which will not retain it, or which will not make use of it if it be retained. It is well to remember how long the human being can go without food without any disastrous results so long as he be supplied with fluid' (Treves).

If, therefore, we find that the patient cannot retain anything when taken by mouth, we should from time to time give her a rectal injection. There are some writers, such as Treves, who think that the main benefit derived from nutrient enemata is

due to the fluid introduced, and they hold that a legitimate difference of opinion may still be permitted whether the solid part of the enema is digested, absorbed, and made use of as food. If his views were correct, all that one need do is to inject ½ pint of saline fluid into the bowel from time to time until the stomach is able to retain some food, and when the patient is strong, this is undoubtedly all that is required. On the other hand, when the patient is much exhausted and her vitality is low, we think that such saline injections are insufficient, and there is abundant evidence now to show that the bowel is capable of absorbing predigested food, and that after a section rectal feeding is a temporary supplementary expedient of great value, for by its means we are able to supply quite sufficient nourishment to maintain nutrition in weakly women, because the metabolism in these patients is so depressed that it requires little to maintain it. As Greig Smith remarks: 'As regards the supply of nourishment, enemas are not in operation cases usually administered because the patient is famished for want of food, but because we wish to provide temporary support to enable the patient to tide over a few days of exhausting sickness.

When, then, shall we give the enemata? **What** shall we give? and **How** shall we give them?

If the patient be strong, we need not give any injection for the first twelve hours; after this, if the vomiting be severe, we may give a nutrient enema every four hours.

If, however, the patient be weak and has lost blood, we make a practice of injecting into the bowel immediately the patient is removed to her bed 2 ounces of Carnrick's liquid peptonoids in 2 ounces of saline. We know of no food from which so much benefit can be derived so quickly as from Carnrick's peptonoids. When given diluted with saline this food is not irritating to the bowel, but if given undiluted it cannot be continued for more than twenty-four hours.

After four hours we may again inject Carnrick's peptonoids. and we may take the opportunity of adding any drugs to the injection that we may desire to administer. Thus we frequently add acetate of potash or digitalis to act on the heart and kidneys.

While we usually rely on Carnrick's peptonoids for our injections, there are cases in which we prefer to use other foods, either alternately with the Carnrick or altogether. The cases in which the Carnrick is not suitable are those in which the kidneys

are affected, or in which hæmorrhoids are present. In the former the alcohol contained in the Carnrick may irritate the kidneys, while in the latter it may so irritate the piles that the enema is only retained for a few minutes. In these cases we resort to milk and egg enemata.

When these foods are employed for enemata, they should be peptonized before being introduced into the bowel, for although Ewald maintains that peptonization is not necessary, and others have shown that the rectal contents contain a proteolytic ferment and a slight amylolytic power, it is logical to suppose that peptonization will greatly aid the absorption of the nutrient elements of the enemata.

If milk be employed for the enema, it is best prepared by placing one of Fairchild's zymine powders in a quart bottle and adding a little water. Then pour a pint of fresh milk into the bottle, and place the bottle plugged with cotton-wool in a can of hot water. Here it may remain until the water begins to get cool, when the latter may be changed. This process may be continued for some hours, because the bitter taste developed by prolonged peptonization of the casein is of no consequence, as the patient does not take the milk by mouth.

Four ounces of this peptonized milk (temperature 98° F.) may be injected alone, but we always prefer to dilute it with 4 ounces of saline and inject it high up into the bowel, after having passed a rubber catheter up above the ampulla into the upper bowel. The higher up the enema is placed, the less will be the liability of its rejection, and Hemmeter* points out that an anatomical and physiological reason for placing injections high is founded on the nature of the anastomosis of the vascular supply of the rectum, sigmoid, and colon.

The superior rectal and sigmoid veins communicate with the inferior mesenteric veins, therefore these veins conduct whatever they have absorbed directly to the liver through branches of the vena porta. In the liver the very important secondary digestion takes place.

The veins from the lower part of the rectum communicate with the inferior vena cava, and their contents are not conducted to the liver directly.

The injection should not be made with a syringe, but by

* 'Diseases of the Intestines,' vol. i., p. 313.

means of a funnel, to which is attached a piece of rubber tubing ending in a small glass tube, which is affixed to the catheter or special rectal tube, made of stout rubber so that it will not easily kink.

After a section the patient will usually lie on her back, and it may be a little troublesome for the nurse to guide the catheter up above the ampulla. This may be done far more easily if the patient is placed on her left side, and a small pillow slipped under her buttocks.

After having given several of these enemata, the bowel will become so irritated that they will have to be discontinued. In order that we may continue these rectal injections with success, the nurse must be warned never to introduce brandy or carbonate of ammonia in a small quantity of water by means of a ball syringe.

After having administered three enemata, the bowel should be washed out with an enema of hot water and turpentine, and after the bowel has emptied itself we may find it a good plan to inject some Vibrona wine ; this is a port wine containing quinine. Thornton was accustomed to add to each injection a few grains of quinine and a tablespoonful of port wine if the refuse from the rectal feeding became offensive, for he maintained that septic mischief may be set up by the retention of putrid enemata in the rectum, the mucous membrane of which has become sore.

Instead of using plain peptonized milk, we may, with great advantage, add eggs to the enema, because, as Ewald has pointed out, that, although eggs contain a small proportion of peptone, they are rapidly absorbed, and are a great gain to the organism. A useful egg enema is the following: Beat up two eggs with 3 or 4 ounces of warm milk, add a dessertspoonful of liquor pancreaticus, and 20 grains of sodium bicarbonate. A tablespoonful of brandy may be added* (Burney Yeo).

* Milk, as Sir William Roberts has pointed out, is much more readily digested by pancreatic extracts than by artificial gastric juice ; but in the case of egg albumen the advantage lies decidedly with the gastric juice. When egg albumen is boiled it is attacked with energy both by the gastric and pancreatic ferments. It follows from this that if we are using egg enemata only that it will be more expedient to prepare them with hydrochloric acid and pepsin, but before injecting such enemata the fluid should be made neutral by soda, so as not to irritate the bowel. If the process has been completely carried out, the addition of the alkali will not precipitate any acid albumen, as the albumen is now converted into peptone. We may with

The following enemata may be tried :*

BOAS' ENEMA.

Milk, 250 c.c.
Yolks of 2 eggs.
A pinch of salt.
Red wine, 15 c.c.
Starch or arrowroot, 15 grammes.

REIGEL'S ENEMA.

Milk, 250 c.c.
2 or 3 eggs.
2 or 3 pinches of salt.
Red wine, 30 c.c.

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advantage now inject these peptonized eggs along with saline fluid, because the addition of chloride of sodium greatly facilitates (as Huber has shown) the absorption of the eggs (by setting up antiperistalsis ?—Grutzner).

In one case where we excised the cæcum and inserted Paul's glass tubes, egg enemata injected into the rectum always ran from the upper tube two hours afterwards.

In another case, that of a child aged ten years suffering from appendicitis, the cæcum was adherent to the parietes. Being unable to locate the abscess, we made a small opening in the cæcum and inserted a finger, and found the position of the appendix by palpation. The abscess being then opened, the bowel was stitched. Four days later the nurse inadvertently gave the child an enema of $\frac{1}{2}$ pint of fluid. The stitches in the bowel gave way, and a fæcal fistula was established. We injected by means of a small ball syringe 15 grains of salicylate of bismuth into the rectum, and found that the fæces issuing from the fistula had the characteristic dark colour in a few hours.

A few days later we injected a few ounces of milk just into the rectum with 15 grains of bismuth, and in two hours found that the milk was discharged, curdled and coloured by the bismuth from the fistula. During that day it is to be noted that a motion was passed from the rectum showing that there was peristalsis in the normal direction as well as an antiperistalsis. Starling suggests that such phenomena may be accounted for by the pendulum movement of the bowel.

The case also shows that $\frac{1}{2}$ pint of water injected into the rectum quickly finds its way to the cæcum, and in this case with sufficient force to burst the stitches in the bowel.

In a third case a fæcal fistula formed in the small intestine, due to a coil of bowel adhering to the bottom of the abdominal incision, which was opened on the third day, when the patient was irrigated for septic peritonitis; 20 grains of salicylate of bismuth was injected into the rectum, and this was discharged at the fistula in twelve hours.

* 'Food and the Principles of Dietetics' (Hutchinson).

TOURNIER'S ENEMA.

Beef-tea (or raw beef-juice), 140 to 150 c.c.
The yolks of 6 eggs.
2 small spoonfuls of salt.
Red wine,* 20 to 40 c.c.

Diet during the Second and Third Day.

As a rule, the patient's stomach becomes settled about forty hours after the operation, and if the bowels have acted well the patient may be given a cup of weak tea. This is a luxury which few women will forego, and Australian women, who are noted tea drinkers, will generally beg for a cup of tea on the morning of the third day (forty to forty-eight hours) after the operation. Others prefer a cup of coffee, and if the vomiting is troublesome, a cup of black coffee will often have an excellent effect on them.

During the second and third days the diet should still consist of milk and Vichy water, somatose, beef-tea, cold chicken jelly, and Carnrick's peptonoids. If the patient be doing well she may be able to take a small quantity of Benger's food.

Egg albumen is a useful food, and it has proved of service in our experience. It is prepared (Kelly) by beating up the whites of four eggs into a liquid froth, and allowing it to stand in a cool place for an hour or more, when about 2 ounces of liquid albumen may be drained off, leaving the frothy part behind. Another way of preparing albumen is to pour the white of one egg over half a glass of finely-crushed ice, stir gently, and add a little sugar and lemon. Egg albumen should be made fresh every six to twelve hours, according to the time of year. It is best given a teaspoonful or two at a time, mixed in two or three tablespoonfuls of cold water with a little sugar, and five or ten drops of lemon-juice; if preferred, a teaspoonful of sherry wine may be added. Kelly recommends this egg albumen because it is tasteless, and at the same time a most nutritious food.†

* Hutchinson says: 'Red wine is recommended as an addition by many Continental writers. The alcohol which it contains is readily absorbed, while its astringency and slight acidity seem to favour retention of the enema.'

† As the egg albumen has to be converted in the stomach into peptone before it is absorbed, it would appear more logical if this process were commenced outside the body by adding some pepsin and acid to it. Sir William Roberts has shown that beaten-up eggs will pass through the stomach when it is weak 'without being meddled with.' Penzoldt's experiments show that

During the third day the patient may begin to get her appetite back, and she may then have half a cup of mutton or chicken broth, or several spoonfuls of chicken jelly fresh from the ice. She may also have sherry whey and junket and wine jelly, while on the fourth day we may allow her some oyster soup, from which the oysters have been strained. On the fifth day she will enjoy a poached egg and a little bread-and-butter, and she may have a few oysters or a little boiled fish with egg-sauce at mid-day. Gelatine blanc-mange is a favourite food of ours, and many patients welcome it towards the end of the first week.*

By the end of the first week she may take eggs, oysters, fish, sweetbread, chicken, sheep's brains, tripe, milk puddings, boiled custard, jellies, blanc-mange; we do not, however, allow any vegetables until ten days have elapsed from the time of the operation. There is no objection to her sucking a ripe orange at the end of the first week.

During the second week we may give her at eleven o'clock in the morning and during the afternoon a drink composed of a tablespoonful of whisky, a tablespoonful of boiled custard, with 4 ounces of aerated water. Patients usually relish this drink very much.

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a lightly-boiled egg remains in the stomach for one and three-quarter hours, while a raw one remains two and a quarter hours. Jaworski and Glazinski found that the white of egg, finely chopped and mixed with water, remains in the stomach one and a quarter hours.

* This useful food is prepared in the following way: Take 1 quart of fresh milk, place 1½ pints of it in a double-lined saucepan. Soak 1 'quart' packet of gelatine in the remaining ½ pint of milk for two hours. Then stir this milk and gelatine into the milk in the saucepan now brought to boiling-point, and add two dessertspoonfuls of sugar and a little flavouring. Beat well the yolks of two eggs and stir them into the saucepan. Leave the saucepan on the fire for three minutes, and then remove it, and add to the contents the white of one egg which has been beaten to a snow. Now turn the whole into a shape previously cooled in cold water; allow the contents to set, and place the shape either in a cool place or in an ice-chest.

CHAPTER XXIII

THIRST

EVERY section case suffers from thirst in a greater or less degree, and to many patients this thirst is even a greater trial than their pain.

In endeavouring to arrive at any conclusion as to the etiology of the thirst that follows after cœliotomy, we may consider that the thirst is both local and general.

The local thirst is due to the dryness of the mouth and the fauces. After all operations which have occupied a considerable period in their performance, the patient complains of this dryness of the mouth and fauces, and it appears to us that the inhalation of the anæsthetic, by causing a hyperæmia of the mucous membrane of the fauces, is a factor in its production.

The next factor in this dryness is a deficiency in the amount of saliva. We have frequently noted, when examining a patient's tongue after a section, that although the surface may be dry, yet the patient may be able, by closing the mouth and moving the tongue about, to collect sufficient saliva to spit freely into a dish if desired. In other cases, no matter how they may try, they cannot succeed. They can only raise a little thick, tenacious mucus. Speaking generally, the first class of patients will be found to have suffered little shock, and show no signs of peritonitis, while the second class have an increased pulse-rate and a raised (sometimes a lowered) temperature. Thus, while it is quite true that the mere opening of the peritoneal cavity is followed in all cases by thirst, it is to be noted that the degree of thirst is largely regulated by the amount of shock.

The absence of saliva after a section is probably explained in part by assuming that the reflex secretion of the saliva has been inhibited by the stimulation of the sensory nerves of the intestines, for Pawlow showed that the mere withdrawal of a loop of

intestine will stop the secretion of the saliva ; and we must admit that in cases complicated by shock and peritonitis—conditions always characterized by excessive thirst—that we have not only an irritation of the sympathetic, but the blood-supply to the salivary glands is greatly diminished, and consequently the exudation, which normally takes place into the lymph spaces adjacent to the secreting cells of the glands, is also greatly diminished, and this helps to lessen the secretion.

Another factor which tends to cause a diminution in the salivary secretion is the administration of morphine and atropine both before and after the operation ; the fauces becoming dry, the sensation of thirst is developed.

Turning now to thirst as a symptom of a *general* condition, the most potent factor that we have to deal with is hæmorrhage. It has been said that the needs of the economy for water are expressed by the sensation of thirst, and this is the case after hæmorrhage, where the tissues are drained to supply fluid to the blood.

All patients that suffer from shock suffer intensely from thirst. All varieties of shock have thirst as a symptom ; it is therefore probably due to a combination of factors.

After a section we know that the specific gravity of the blood increases.* There is an escape of lymph out of the blood into the injured peritoneum, and the blood endeavours to make good this loss by drawing on the fluid in the muscles and other uninjured tissues. For a time this reserve of fluid is sufficient to prevent any alteration in the specific gravity of the blood, but a point is reached when the reserve of fluid in the uninjured tissue is exhausted, and then the specific gravity of the blood rises, and may remain for some days higher than it was before the operation, and during this period the patient suffers from thirst. When, however, the organism has been supplied with sufficient fluid, the tissues again receive their proper supply, and the thirst diminishes.

In both shock and peritonitis the accumulation of the blood in the abdominal vessels leaves the tissues anæmic and deprived of lymph, and the insatiable thirst of severe peritonitis no doubt is largely to be accounted for by the loss of fluid by vomiting and

* Cobbett states, on the authority of Grünbaum, that the specific gravity of the blood increases during the performance of a section (Allbutt's 'System of Medicine,' vol. iii., p. 329).

its escape into the peritoneal cavity and accumulation in the abdominal vessels, causing a diminution of the lymph in the tissues—far removed from the peritoneal cavity—and this accounts for the pinched look that accompanies advanced peritonitis.

Lastly, we must not forget that while very little is known definitely about the thirst centre of Nothnagel, it is more than probable that any condition after a section which causes a rise in temperature will influence that centre, and so cause a local thirst: while quite apart from any special centre, we know that a rise in temperature causes the expired air to dry the tongue and fauces, and this gives rise to the sensation of a local thirst.

Treatment.—At one time it was laid down as a rule that no matter how intensely the patient might suffer from thirst, yet she was to have no fluid administered by the mouth for twenty-four or even forty-eight hours following the section. This practice was founded on the idea that if the blood was deprived of a certain amount of fluid that absorption of fluid from the peritoneal cavity would be aided, and consequently there would be less risk from sepsis starting in an exudation. Lawson Tait warmly advocated this abstinence from fluids, and his views are given in his lecture on peritonitis:* 'Another matter regarding which my convictions were altered very early in my practice was that strange unaccountable thirst which inevitably follows the opening of the peritoneum, even in a mere exploratory incision as much as in a protracted and severe operation. Cut down through the abdominal wall to the peritoneum without damaging the membrane, and there is no thirst—at least, it is rarely seen, and is then very transient. But open the peritoneal cavity, and you have an invariable symptom—intolerable thirst lasting from twenty-four to sixty hours. At first I thought that this was a clear natural indication that the patient should have plenty of fluids and plenty of ice. But I have long since come to regard ice as one of the things which should be banished absolutely from the sick-room. It never acts in any other way than to increase thirst, and the best thing to allay thirst after an abdominal section is warm water. Gradually I found it wise to diminish the quantity of fluid after an operation to the vanishing point, and now I keep my patients

* *British Medical Journal*, November 12, 1892.

for as nearly forty-eight hours as may be in absolute starvation—this being modified, of course, by age and previous exhaustion. I have, indeed, come to regard this thirst not as an indication for the administration of fluids, but, on the contrary, as an indication that the traumatism of the peritoneum has attacked its flow and ebb in some strange way, and that the less fluid there is about, the sooner will the natural rectification of the process be effected. Certain it is that, since I have adopted this policy, sickness after operation—I do not mean mere anæsthetic sickness, but the dreaded sickness of the second and third day—has almost disappeared, whereas formerly it was almost a routine symptom.'

These views have a considerable influence on the practice of many surgeons. Christopher Martin,* who was Tait's chief assistant for many years, warmly advocated these views, and in 1893 wrote that 'for forty-eight hours after the operation she must be starved, and not allowed to swallow even a teaspoonful of water. She suffers cruelly from thirst, but I am convinced that this forced abstinence from fluids is very beneficial.' In 1896 we find Greig Smith protesting against this line of treatment, and declaring that 'total abstinence from fluids for forty-eight hours or even four hours is, in my belief, quite unnecessary. . . . In three or four hours sips of hot water or weak tea or toast-water may be given by the mouth, and in from twelve to twenty-four hours some liquid nourishment may be given by the mouth as well.'

In 1898 we find Martin has changed his views: 'I am glad to say I have satisfied myself that this forty-eight hours' deprivation of fluid is not only cruel, but unnecessary and harmful. I seldom keep a patient more than six hours without fluid.'

At the present day the almost universal habit is to give the patient fluid after five or six hours, and the fluid that has proved most satisfactory is hot water. But while it is quite a proper thing to give the patient sips of hot water, we must not allow her to keep on taking this fluid whenever she may desire it, for we must remember that after a long and exhausting operation the stomach is inert, and absorption will take place only in a minor degree; to give large quantities will mean that the fluid taken will collect and cause increased vomiting. With regard to

* 'The After-treatment of Cases of Abdominal Section,' London, 1894.

ice there is no second opinion ; now it is on every side condemned, for the ice causes a hyperæmia of the vessels of the mouth and throat, and this in time leads to an increased and insatiable thirst, and the ice is frequently made of impure water, which collects in the stomach and upsets it.

Our own practice varies according to whether the patient continues to vomit or has nausea. If the patient continues to vomit after becoming conscious, it will only add to her misery to give her any fluid to swallow, whether the fluid be hot or cold. One should make it a rule not to give anything by mouth when the patient's stomach rejects it soon after; the most we should do is to allow the patient to rinse her mouth with a little warm water, or to suck the end of a towel that is dipped in water from time to time.

Another method that we have tried, and one that gives some relief, is to place a large piece of ice in a tumbler, and allow it to stand for a little until the glass is cooled. The patient may then open her mouth and protrude her tongue, so as to rest the bottom of the glass on it, at the same time biting the side and the bottom of the tumbler. If the eyes are closed the patient gets the impression that she is really biting the ice, and the cool glass thus gives her some comfort, and does no harm.

If the patient, then, is not inclined to vomit, we may without hesitation give her teaspoonfuls of warm water, or Vichy water, beginning four hours after the operation. Warm water certainly gives more relief than cold water, and the patients are not so eager to take it. In giving this warm fluid we should be careful not to use a metal spoon, or we shall soon blister the patient's lips; a horn or a wooden spoon is to be preferred. We may give fluid by the mouth in small quantities every fifteen minutes until twelve hours have elapsed from the time of the operation, when we may commence with milk or whatever food we intend to administer.

A convenient glass for giving fluids from is shown in Fig. 89.

If the tongue is very dry some relief may be given by squeezing a few drops of fresh lemon into a teaspoonful of glycerine, and then painting this on to the tongue; or we may give the patient a few ounces of Semmola's glycerine drink, which is made by adding 1 ounce of glycerine and 30 grains of citric acid to a pint of water.

We have sometimes tried the 'chewing-gum' used by bicycle-

riders to see if this would give the patient any relief; but neither this nor the plan of rolling a glass bead under the tongue has ever done any real good.

Undoubtedly the most effectual way of relieving both general and local thirst is by administering a saline enema before the patient leaves the operating-table.

Clark has shown that by introducing a rectal tube up to the sigmoid flexure, and running in a quart of normal saline solution—the patient's buttocks being slightly elevated—the fluid gravitates into the descending colon, and will be retained if the patient is still under the influence of the anæsthetic.

At any time after the operation the same injection may be given, but it is well not to inject more than a pint of saline at a time.

The plan of leaving saline solution in the abdominal cavity at the conclusion of the operation, and the giving of submammary injections, are also helpful in relieving general thirst; and we should remember that while we are preparing the patient for the operation, if we purge her severely with sulphate of magnesia, we should be careful to allow her to have abundance of fluid, so that when she comes to be operated on the tissues will have a proper reserve of fluid on which the blood may draw.

We believe that if very large quantities of saline solution are injected subcutaneously that the patient gets a local thirst; and it has been shown by Fourmeaux that puerperal septic women, who have received large quantities of saline injections, have for days a salty taste in their mouth, and crystals of salt may be found on their lips.

In all cases where the patient is suffering from great thirst the nurse should not leave any water-bottles within sight of the patient. We know of an instance where the patient rose from bed a few hours after her operation, and walked across her room so as to empty a water-bottle, and returned to bed without disturbing the glass drainage-tube. Other instances have been related where the patients have drunk the water out of one of the hot-water bags that surrounded them in bed.

CHAPTER XXIV

PAIN AND SLEEP

As the patient becomes gradually conscious she will begin to complain of pain.

The amount of pain that patients suffer after a section varies very much. There are a small number who never seem to suffer at all, while in other cases patients are almost distracted with their agony. This is all the more curious, inasmuch as the magnitude of the operation bears no relation to the degree of pain, for it is after comparatively small operations, such as the removal of ovarian cysts without adhesions, that the greatest amount of pain is complained of. We have often seen large fibroids removed, and the patients make no complaint whatever afterwards.

The pelvic pain after simple operations is undoubtedly due to the constriction of the pedicle by the ligatures, and there appears to be more pain if the pedicle is tied in a mass than if it is tied off by separate sutures, which embrace only small quantities of the broad ligament. After observing the results of some of our colleagues' operations, we believe that patients complain of more pain after employing silk ligatures, as we do, than after employing wallaby tendons, as they do.

If there have been extensive adhesions, and the bowels have been much handled, then there is usually severe pain for the first twenty-four hours; on the other hand, the most densely adhering pus tubes may be enucleated, and yet the patient may be quite easy afterwards.

If we employ a glass drainage-tube, and this is forced down so that it presses on the rectum, the patient will always complain very bitterly of the pain, and this pressure on the bowel will give rise to reflex vomiting.

Patients do not complain of a gauze drain, especially if it be

placed entirely in Douglas's pouch and the end brought out into the vagina.

Undoubtedly the chief cause for pain after a section, apart from compression of the pedicle, is due to the rapid distension of the bowel with gas, and as this cannot be dispelled with freedom, partly from the unwillingness of the patient to use her abdominal muscles, partly from the ineffectual peristaltic movements, she consequently suffers from colicky pains, which of all pains are the most trying to her fortitude, because she is unable to turn about and double herself up in bed to get that relief which movement and pressure give when in health.

After the first thirty-six hours the pains that are due to the compression of the ligatures die away, but the pains arising from tympanites grow worse, and if the patient is beginning to suffer from peritonitis she has added to her enteralgia a general tenderness of the whole abdomen. Should the inflammation increase, the patient strikes an attitude, her legs drawn up, and her belly walls rigid, and this is the outcome of an endeavour to relieve her suffering.

When the abdominal incision is made in the median line, the patient complains very little of pain in the region of the wound, unless she happens to develop a cough or the vomiting is severe.

We believe that patients suffer less when the incision is closed in layers than when it is closed by through and through sutures.

We have frequently known patients to complain of severe pains about the lower ribs and sternum after a section, and we have generally remembered that the anæsthetist had resorted to artificial respiration during or after the operation. Again, if the patient has been placed in the Trendelenburg position, she will complain of pains about the clavicular and scapular regions if the metal shoulder supports have not been well padded. These supports are only to prevent the patients slipping toward the anæsthetist, and on no account should they be employed to support the weight of the patient's body. On the other hand, patients not unfrequently complain of pains in the popliteal region, and this is due to the ridge over which the leg has been placed while the patient is suspended. Some observers have noticed that this pressure has excited phlebitis, and this has caused the pain complained of.

If submammary transfusion has been practised, the patient

will complain of great tenderness in her breasts for some days after the operation.

Lastly, few patients undergo a section for pelvic disease without experiencing an intense aching in the lumbar and sacral regions, which lasts for some days after the operation.

Treatment.—The treatment of pain after a section leaves much to be desired. We are in want of some drug that will not affect the action of the bowels, that can be used hypodermically, and will produce sleep without affecting the action of the heart.

Morphine is given after every section by some surgeons, for they maintain that a small quantity ($\frac{1}{4}$ grain) will not paralyze the bowels, and will not cause more vomiting than will naturally occur after administering an anæsthetic; they hold that the injection, by dulling the sensibility, helps to prevent or cut short shock, to lessen hæmorrhage, and to tide the patient over the first hours of her most intense pain, and by inducing sleep restores her strength.

Other surgeons, who have ever before their minds visions of pseudo-ileus and peritonitis, leave their patients to undergo the most intense suffering rather than break through their rule of never administering morphine. They maintain that this drug decreases the functional action of the stomach and intestines, liver and kidneys; that it paralyzes the muscular coat of the bowel, prevents the expulsion of gas, and favours the retention of excrementitious materials. Should peritonitis set in, the bowel, now partially paralyzed by the drug, is further paralyzed by the peritonitis, and the micro-organisms more readily pass through the walls of the distended intestine.

They further maintain that it increases vomiting, retching, and nausea; that it decreases the phagocytic action of the blood elements against invading pathogenic micro-organisms, and it also decreases the power of the lymphatics to take up and destroy products of bacterial activity.

Our own practice has varied from year to year. At first, after leaving Mr. Tait, we looked upon morphine as one of the curses of abdominal surgery. But time has shown us how erroneous such an idea is. Our present practice is to give no morphine in the majority of cases operated on. If, however, the patient has had a simple operation performed, such as the removal of a small ovarian cyst, or a ventro-fixation of the uterus—cases in which we are absolutely sure that peritonitis will not supervene

—then if by eight o'clock on the evening of the day of operation we find that she has no inclination to sleep, and she is tossing about and complaining of much pain, we give her two capsules, each containing 10 grains of trional, and we wait for three hours. Should she vomit these capsules, or if she retains them and she still is in pain and shows no inclination to sleep, then we order her morphine ($\frac{1}{8}$ grain), but we do not repeat this. We know that next day she will have more nausea and more vomiting than she would have had if she had not been given the morphine, and we know that the bowels will be more distended, and that she will have more colicky pains; but as we are certain that the case was one without septic complications, we do not hesitate to let her endure these disagreeable effects so that she may gain some sleep and rest during the first night.

If, on the other hand, the patient has undergone a long and severe operation, such as the enucleation of adherent pus tubes, we refrain from giving her morphine, even though she is in much pain. Such patients are generally stupid from the anæsthetic for some hours, and their pain will not usually be so intense as in the cases where the healthy tissues have been constricted by the ligatures, while long suffering has made them better able to bear their sufferings, which have consequently less effect on them. We withhold morphine from such patients because we have been dealing with septic tissues, and we know that an action of the bowel on the morrow may be of the greatest importance to the patient's safety, and we have no desire to increase the vomiting from the anæsthetic, which may be a serious factor in keeping up the shock and exhausting the motor centres of the brain. If, however, we are dealing with elderly women, who, after the operation, become very restless and bemoan their lot, regretting that they underwent the operation, and declaring that they will die if they are not allowed to sit up or to get out of bed, then with such people an injection of bromide of soda or trional by the bowel, followed by a hypodermic of morphine ($\frac{1}{8}$ grain), will act most satisfactorily, for they fall into a deep sleep and awake refreshed and cheerful.

We may lay it down, then, as a rule that mere pain, unless it be excessive, is not an adequate reason for the administration of morphine after a section, unless we are dealing with children and old people. The surgeon will not have done many operations before he will be struck with the extreme difference between

individuals with regard to their power of enduring pain. Country women, muscular women, and women on in years often bear pain most heroically; but the pampered, the hysterical city dweller, especially the nullipara, screams and throws herself about the bed in an excited manner, hardly knowing what she is doing, and implores the nurse and the surgeon to give her something to relieve her suffering. Such cases as these soon exhaust their little reserve of strength, and if they do not get relief they very speedily collapse. The nurse dealing with such cases should endeavour to use a certain amount of moral suasion, and should, on the understanding that the patient will endeavour to keep still, inject 10 minims of salt solution or of peroxide of hydrogen under the skin. If the pain is not very real this, with a large dose of bromide or trional by the bowel, may cause the patient to get some rest.

If, however, the pain is real and acute, the patient will soon begin to be restless again, and we must then give morphine, and repeat it if necessary; for if we give only $\frac{1}{8}$ grain at first, we shall sometimes find that the patient becomes more excited than before, and the nurse may have some difficulty in keeping her in bed.

Greig Smith, who was much opposed to the administration of morphine, being a pupil imbued with Tait's teaching, was of opinion that restlessness and jactitation were symptoms that more urgently called for its administration than mere pain, and we quite agree with this opinion.

We now more frequently give morphine during the second night if the patient has had a motion and if she is doing well, but has no inclination whatever to sleep. She lies in bed wide awake, and tells you that if she could only have a sleep she would be well. If trional and brandy have failed, we have no hesitation in ordering morphine ($\frac{1}{8}$ grain), and have usually found that the patient was well and strong the next day.*

Another case in which morphine may occasionally be employed, is when the patient is racked with violent but fruitless peristaltic contraction of the gut, evidently due to some spasmodic stricture at an angle; here, after administering $\frac{1}{8}$ grain, the wind will pass, and the bowel cease its fruitless and spasmodic efforts.

Occasionally we are called upon to operate in cases where the

* It is only of late that we have appreciated the wonderful effect that minute injections of morphine can produce. I have known a restless patient sleep for eight hours after an injection of $\frac{1}{12}$ grain of morphine.

patient has been accustomed to have constant injection of morphine before the operation. These women cannot suffer much pain; they have been so accustomed to obtain relief from the hypodermic needle that they beg for an injection after the operation. To withhold morphine from such women during the hours that immediately follow the operation, when they are in real pain, is, in our opinion, a piece of unnecessary cruelty. They are so accustomed to the drug that $\frac{1}{4}$ or $\frac{1}{2}$ grain can do no harm, as the morphine does not affect the bowels to such a degree as in those unaccustomed to it.

Recently we were called upon to operate upon a woman who was seven months pregnant, and who had been suffering from biliary colic. She had been given morphine constantly, but the pain from the gall-stones became unbearable. After an operation, in which we removed the eight stones that were in the gall-bladder, she implored and begged for some morphine, and we utterly failed to quieten her until she had received $\frac{1}{4}$ grain. We were very loath in this instance to give the drug, because the patient suffered from constipation, and on account of the intestines being crowded up by the pregnant uterus we feared obstruction. The patient received an occasional injection of morphine after the first day, but usually the nurse only administered normal saline, which satisfied her, as she was unconscious of the trick played her. When, later on, this was pointed out to her, it had an excellent effect on her, and before she left the hospital she had entirely overcome her desire for morphine.

As we have said, while the aged require the administration of morphine after sections, so also do babies and young children.

Dr. Clubbe of Sydney, who has had an exceptionally large experience in operating on children, says: 'In babies after intussusception I always give $\frac{1}{40}$ grain of morphia directly after the operation, and this has often to be repeated if the child is not resting.'* Our own experience is in accord with his, and we think that morphine injections should be the rule rather than the exception after sections performed on children.

If we are to withhold morphia—and, in spite of what we have urged in its favour, we still are of opinion that its administration is to be the exception, not the rule—what drugs may we fall back on to produce sleep?

* *Australian Medical Gazette*, February 20, 1901.

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We have adopted the same plan with hypnotics as we have done with cathartics: we have tried various drugs separately and in combination on the patient in the ward after general operations, so as to ascertain what drugs are most likely to be of service after sections.

If the patient is strong, and is not suffering from shock, we have found the following enema of service:

℞	Ammonii bromidi	ʒss.
	Chloralis hydratis	grs. x.
	Liq. opii sed.	♏xv.
	Succi hyoscyami	ʒj.
	Aquæ	fl ʒj.

Misce, pro enemate, statim injicendo.

Inasmuch as chloralamide is capable of relieving pain while it produces sleep, we propose to substitute this drug for the chloral in the above prescription. It may be given in doses of 20 grains dissolved in brandy.

We have also obtained good results with trional given by the mouth in cachets containing 10 grains. One cachet is given, and the second is administered one hour afterwards. If these have no effect bromide of ammonium (30 grains) is given by the bowel, and if the patient then shows no signs of sleep morphine ($\frac{1}{8}$ grain) is tried.

In hysterical cases, where the patient is strong but very restless, hydrobromide of hyoscine ($\frac{1}{150}$ grain) may be tried if there is any reason why morphine should not be administered; this, however, always makes the throat very dry.

Some operators have obtained good results from codeinæ phosphas (2 grains), but we have never seen any relief from pain after its exhibition. It is useful, however, in cases where a hacking cough develops after the operation.

We have frequently tried the plan of administering sulphonal on the evening before the operation, and have found that an enema with trional or ammonium bromide on the evening of the operation enabled the patient to have some sleep. To give sulphonal by the bowel on the evening of the operation is quite useless, unless the patient has had a dose some hours before the operation.

At present, then, morphine is the only reliable drug that we have to produce sleep and relieve pain after a section, and after morphine our best results have been obtained by a free use of trional. We propose to administer it, dissolved in alcohol, hypodermically into the mons veneris, and to note its effect.*

* We have recently tried some experiments on ourselves with succus hyoscyami. We found that 3 ounces taken in four hours did not produce sleep. It caused the head to ache and the throat to become extremely dry.

CHAPTER XXV

PULSE, TEMPERATURE, AND RESPIRATION

Pulse and temperature charts are objects of absorbing interest to the young abdominal surgeon, notwithstanding the fact that some experienced operators are inclined to sneer at those who put great faith in these charts.

Greig Smith was accustomed to say, with regard to 'temperature' after ovariotomy, that it was the least important of all signs. This author appears to have had as little regard for the pulse, for while he makes a few observations on temperature after cœliotomy, he does not deign even to mention the pulse.

This contempt for the temperature chart has its origin in the fact that patients suffering from peritonitis occasionally die with a temperature chart that looks absolutely normal in every respect. These exceptional instances—exceptional, at all events, with regard to peritonitis after pelvic operations—are brought forward as an argument for placing little reliance on the temperature range, the fact being altogether lost sight of that the pulse and temperature charts are barometers to indicate many conditions which are quite as important as peritonitis. A study of many hundreds of such charts, taken after cœliotomy, has convinced us that the pulse and temperature are, with occasional exceptions, most reliable guides.

Tait, with his unique experience, has said: 'Nothing has been to me more instructive than a comparison of a group of such charts, and I have repeatedly seen grounds for a prognosis in a case by the comparison of its temperature range with those of former cases.'

At first the young operator will be inclined to look upon the temperature as his chief guide, but as he gains experience he will soon learn that the pulse will often tell him more quickly, and more surely, the condition of the patient. Lastly, when his

experience has ripened, he will learn that the pulse must always be considered along with the temperature, and that to rely on one without the other leads to the most fallacious conclusions.

In order, therefore, that we may indicate the progress that a case is making, the pulse and temperature curves must be noted graphically on the same chart, the temperature being dotted in with black ink, while the pulse-rate is marked in with red ink.* On the left side of the chart are placed the numbers indicating the degrees of temperature, while on the right side are placed those for the pulse-rate. At the foot of the chart the respiratory-rate may be noted; a graphic record for this is not necessary.

The chart should be ruled in such a way that each twenty-four hours is divided into six divisions, for the temperature and pulse-rate should be taken every four hours until the patient is out of danger, and the time when the observation is made is noted at the upper part of the chart.

In order that the surgeon may appreciate the changes that the pulse and temperature undergo after the operation, a morning and evening record should be made for some days previous to the operation, and the operator should make it his business to study the patient's pulse from time to time, in order that he may become familiar with its character or its peculiarities; this may save him some anxiety after the operation is completed. He should, for instance, note if the pulse can be felt in both arms with equal facility.

The nurse should be careful to indicate on the chart the **date** and **time** when the patient was placed in bed after the operation.

The Pulse.

But if the pulse is to be used as a guide, it will not be sufficient merely to watch its fluctuations in frequency as indicated by the line on the chart; we must take into consideration its rhythm and rate, its tension and volume, the special character of each pulse-wave, and the condition of the vessel between the beats. We shall, therefore, briefly consider each of these in order to point out how they will aid us in estimating the patient's true condition after a section.

Rhythm.—The pulse may be irregular in its time, or there may

* In the charts that follow the temperature-curve is represented by a continuous line, while the pulse-curve is represented by an interrupted line.

be an inequality in its force. In elderly women some days after an operation, if the pulse-rate has been persistently high, we shall occasionally note that a beat is here and there omitted; the intermissions do not occur at regular periods, and are generally regarded as a sign that the heart is growing fatigued, and strychnine and digitalis are called for.

In cases of shock and virulent peritonitis we may get a markedly irregular pulse during the first twenty-four hours, while in cases of septicæmia, when the symptoms have persisted for several days, the pulse also grows very irregular, and this is frequently an indication that the end is approaching.

Flatulence also alters the rhythm of the pulse, but chiefly affects its rate.

Frequency.—As the pulse-rate of the majority of cases is about 80, this may be taken as our normal.

After most sections, for forty hours the pulse-rate is increased 10 or 20 beats, while if any shock be present the pulse-rate may rise to 140 or 160. In some cases, however, of evanescent shock the pulse may be slow and full.

Hæmorrhage from torn adhesions or a raw surface will not usually increase the pulse-rate unless the blood lost exceeds 4 ounces. If the bleeding comes from a moderate-sized artery or a large vein, the pulse will increase at the rate of 20 beats every hour while the hæmorrhage continues. Should a ligature slip from the uterine artery, the pulse may jump to 140 in the first five minutes, and become uncountable in fifteen minutes.

Septic intoxication may cause the pulse to rise to 140 during the first twenty-four hours after the operation.

Peritonitis always increases the pulse-rate to between 120 and 135, and as the end approaches to 150 or 160. Before twelve o'clock noon the pulse may fall to 115, but seldom comes below 100. It is most rapid between twelve noon and midnight. When the case has survived for several days a favourable prognosis may be made if the pulse-rate does not rise above 115 after sundown.

A marked increase in rate on the third or fourth day points to peritonitis, while an increase at the end of the first week may mean a stitch abscess or pelvic abscess.

A sudden increase a few weeks after the operation at the time for the menstrual period should cause us to search for an extra-peritoneal hæmatocele.

Tympanites is always accompanied by an increase in the pulse-

rate. The pulse is irregular, the force of the heart varies frequently, and the rate changes rapidly.

When the bowels act and flatus is expelled, the pulse often falls 20 or 30 beats, and ceases to be irregular. In pseudo-ileus the pulse-rate increases with the distension of the abdomen, increasing in one of Malcolm's cases from 112 to 140 in twelve hours.

Rapid increase in pulse-rate coming on with dyspnœa points to pulmonary embolism; in one of our cases the pulse-rate rose rapidly to 160.

Occasionally the pulse increases to an alarming rate, and for no apparent cause. This is well illustrated by a case recorded by Macnaughton-Jones.* The patient was an extremely nervous woman and very debilitated. Abdominal hysterectomy was performed for myoma. 'She made an excellent recovery, without pain, vomiting, or nausea; the sutures came out without any difficulty, and there was no stitch abscess or trouble of any kind in the wound or peritoneum from first to last.'

Intense pain from the constriction of the pedicle will not cause the pulse to increase more than 10 or 15 beats; the pulse-rate, however, is frequently increased when pain is due to distension of the bowels from gas. Here, however, we have to reckon with the tympanites, and its cause.

On one occasion, after performing partial hepatectomy, the patient was seized, eighteen hours after the operation, with an agonizing pain, and the pulse and temperature rose rapidly, but fell gradually after the injection of morphine.

Rarely do we find a very slow pulse unless the case is abnormally slow (bradycardia). On one occasion, after removing a living four months' ectopic fœtus, the pulse-rate fell below normal, and the pulse resembled the soft, slow pulse so often found during the normal puerperium.

In elderly women with strong hearts, but with some thickening of the vessels, there is often found, even after prolonged operations, quite a slow pulse.

Tension.—The pulse, after a section, may be of high or low tension.

The most typical example of high tension is in well-marked peritonitis without shock. Here the pulse is frequent and small

* Macnaughton-Jones, *British Gynæcological Journal*, May, 1902.

owing to the contraction of the arterioles, and the artery is hard and full between the beats, and not easily compressed.

As a contrast to this condition we have the small, weak, compressible pulse of shock with a low tension, for the arterioles are imperfectly filled with blood, and there is a general relaxation of the vessels; the abdominal veins are overfull; the systole is feeble, for the ventricles are fed inadequately with blood.

Occasionally we have instances of peritonitis, when the poisoning is so acute that the patient exhibits all the signs of shock. In such cases the pulse is weak and compressible.

If a patient has not had her bowels moved for three or four days the pulse will show increased tension during the evening hours, and this is especially to be noted if the tongue is foul; when the bowels act the tension of the pulse becomes less.

As a rule a pulse of high tension, provided the pulse is large, is a good sign; it indicates strength, while a pulse of low tension is a sign of less vigor or of weakness. Thus, where there has been severe hæmorrhage, either during the operation or afterwards, the blood-pressure is always lowered, and the tension is less. In such cases the submammary injection of saline immediately alters the short, small pulse of low tension, the pulse increases in volume, the beats become slower, the blood-pressure rises, and the tone of the vessel is regained.

An increase in the tension of the pulse, taken in conjunction with increased rate and increased duration and fulness of the pulse first in the evening at the end of the first week, should make us search for pus either in or around the wound or in the pelvis.

The uræmic symptoms that set in with persistent anuria after a section, and which are either due to nephritis or to ligature of the ureters, are marked by a slow, full pulse of high tension. When, however, in old and debilitated women the anuria is due to exhaustion or hæmorrhage, the pulse is frequent, small, and of low tension.

Character of each Pulse-wave, and the Condition of the Vessel.—Besides the condition of the pulse already alluded to, the character of the pulse-wave should be noted. Thus, we should consider whether the pulsation is long or short. In the former case, the increased pressure, due to the systole of the heart, can be felt by the finger to last for an appreciable time; in the latter case, the pressure is felt, but it comes and goes quickly, lasting only during a short interval.

In the beginning of peritonitis and septic infection, without shock, the pulse is long; the onset of the wave is gradual, it is felt for an appreciable and relatively long period under the fingers, and it is noticed to subside slowly. If pressure be made on an artery, though it be contracted and small, it will be found that the wave has quite a degree of force. The pulse is also long in the reaction stage of shock.

If, however, we test the pulse in well-marked shock or in hæmorrhage, we shall find that the pulse is quite sudden in its stroke and brief in duration, and it subsides so quickly as to disappear until the next beat. In the last stages of peritonitis we have a very short, small, rapid pulse.

As a contrast to these conditions we may place the pulse of the woman who is progressing favourably a few days after a section. The pulse-waves are felt by the fingers to come softly and firmly, but not suddenly, and if the fingers are pressed more decidedly on the vessel the beat becomes more sudden and vehement. The wave does not instantly drop, as in the low-tension pulse, nor does it remain, as in the high-tension one; it comes and subsides gently.

We should roll the artery between our fingers during the successive beats so as to estimate the fulness of the vessel during systole and diastole, and also ascertain the condition of the vessel's walls. Thus, in peritonitis, the artery remains quite full between the beats, and we cannot easily compress it, while in shock and hæmorrhage, and in the low-tension pulse, the vessel is weak and compressible.

Lastly, while it is the invariable practice to feel the radial artery to ascertain the condition of the pulse, this often gives us a wrong impression of the condition of the heart. This is particularly the case immediately after a prolonged operation, and in cases where the pulse remains slow in spite of a high temperature.

'At the wrist it may be full and hard, or small, feeble, collapsing, and easily compressible. When the latter condition exists, with a slow cardiac beat, if the large arteries in the neck be examined, the impulse in them is frequently found to be full and bounding. Moreover, when the condition of the heart is investigated, it will be observed that the first sound at the apex is loud and distinct, while at the base the second sound is sharply accentuated or, perhaps, reduplicated. In such conditions the

heart is beating powerfully, while the pulse is small and feeble. Hence we must conclude that, although a small, weak pulse may, of course, be due to debility of the heart, yet feebleness of the cardiac pulse at the wrist is not necessarily an indication of weakness.'*

This discrepancy between the pulse-beat and the heart's action may sometimes be observed in cases of transient shock, when the pulse can be scarcely felt at the wrist, but the heart's action is strong, and the pulse in the carotids full.

Pulse and Temperature.

Having considered the pulse by itself, we shall now find it profitable to consider the pulse and temperature together.

In dealing with a large number of charts, we shall find it convenient to group them into four divisions.

1st Division.—In the first division we place all those cases which are not septic at the time of operation, and, on account of the simplicity of the operation and its short duration, we can be almost certain that the case will not become septic. Into this group will come cases of hysteropexy, ovariotomy for simple ovarian tumours, and excision of a hydrosalpinx.

2nd Division.—In this division are placed those cases where we do not think any septic tissues are present, but from the nature of the operation we may have introduced septic germs. Here we may place operation for the removal of many fibroids, or adherent tubes, or adherent ovarian cysts.

3rd Division.—In this group we have cases where the parts removed are found to be septic. Here we place pus-tubes containing active germs, tubo-ovarian abscesses, and pelvic abscesses.

4th Division.—In this division we place the cases which develop—after the operation—accidental affections, such as pneumonia, malaria, or thrombo-phlebitis.

In dealing with each of these divisions we shall select a number of charts, each of which we have come to regard in our own practice in the light of a 'morbid mean,' which supplies us with a standard by which we may make an estimation of the condition of the patient.

We do not use the term 'mean' in the sense that these charts are average or composite charts of a number of cases. Each

* Malcolm, 'The Physiology of Death from Traumatic Fever,' p. 10.

chart is from one actual case, and we select that individual chart because we have come to regard it as the kind of chart we expect after having operated for a particular condition.

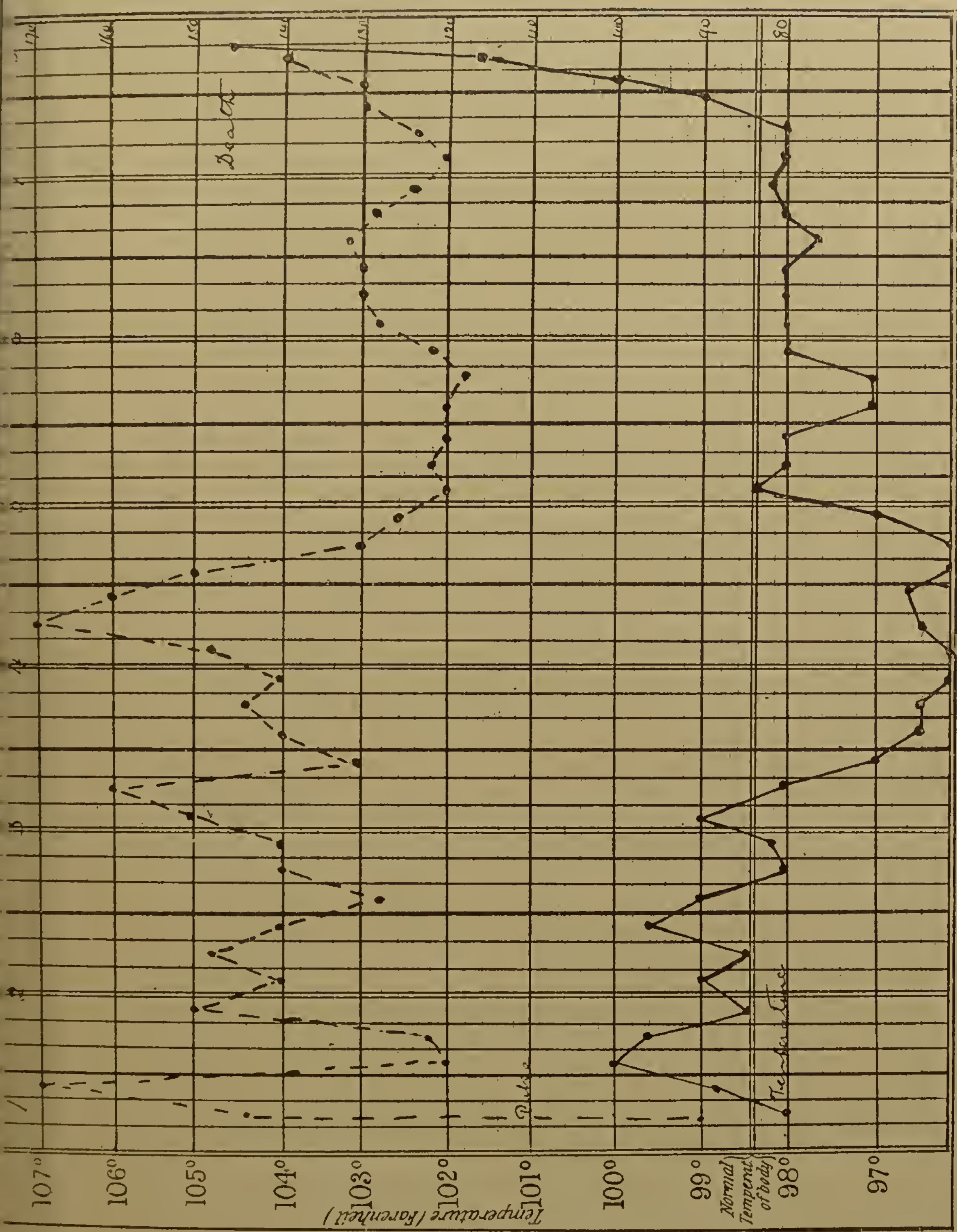

Fig. 95.—Chart after Cholecystotomy for Gall-stones; Malignant Disease of Liver present; Death from Iodoform-poisoning.

That we should at times get a chart utterly at variance with our 'morbid mean' is only to be expected—though this does not detract from our standard, it only serves to draw our attention to

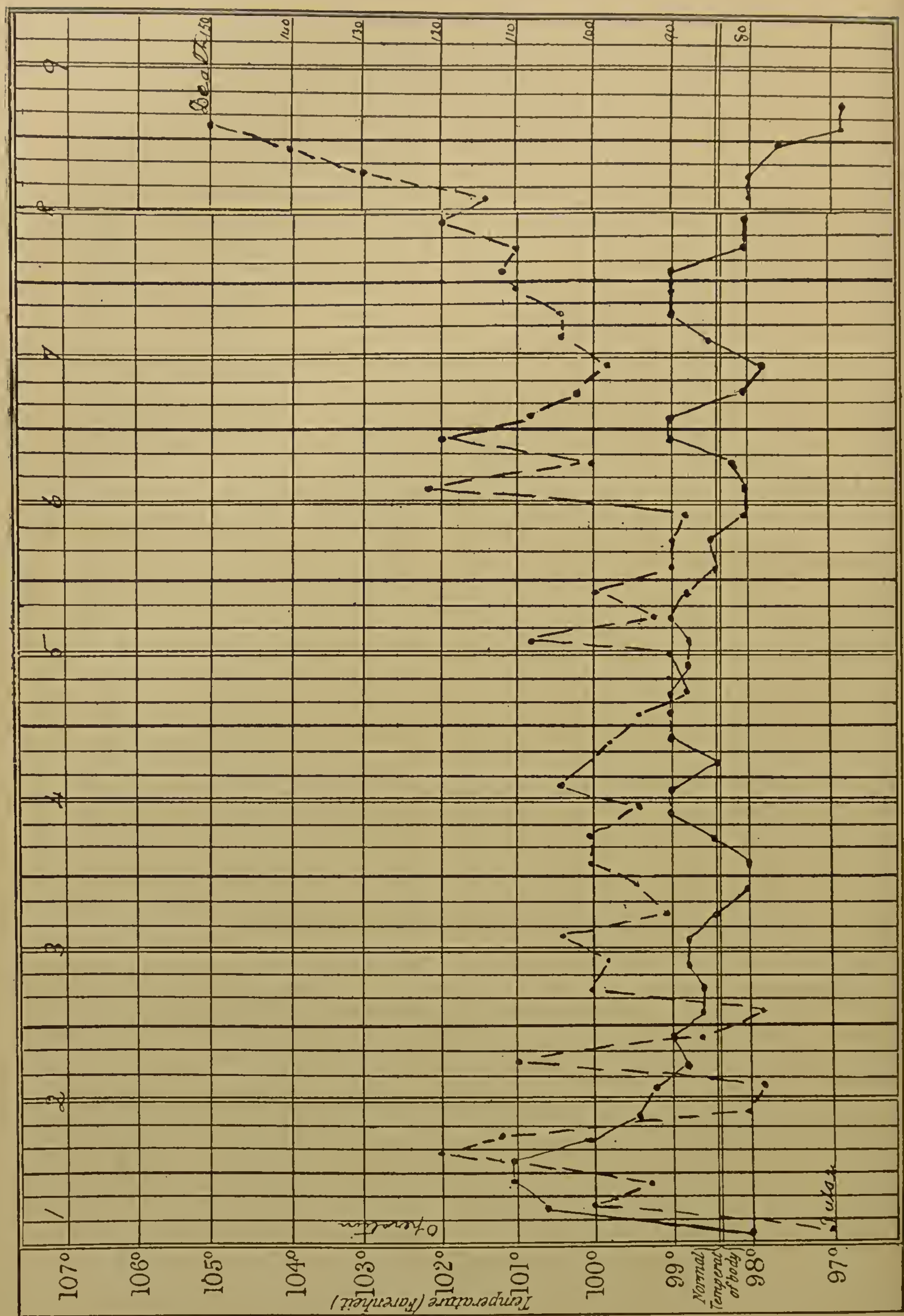

FIG. 96.—Chart after Excision of Cæcum for Malignant Disease; Patient aged Seventy-one Years; Death Due to Heart Failure.

the variation—for while in a simple case, such as a hysteropexy, we are almost certain that the pulse and temperature that follow the operation are the results of our making an aseptic incision in aseptic tissues, we are, on the other hand, unable to predict with certainty what will happen after a long operation—say for the enucleation of adherent tubes and ovaries, because we know that the mere incision in the abdominal walls does not account for the type of chart that we get; the curves of the chart, in fact, depend not on one antecedent or one event—*i.e.*, the making of

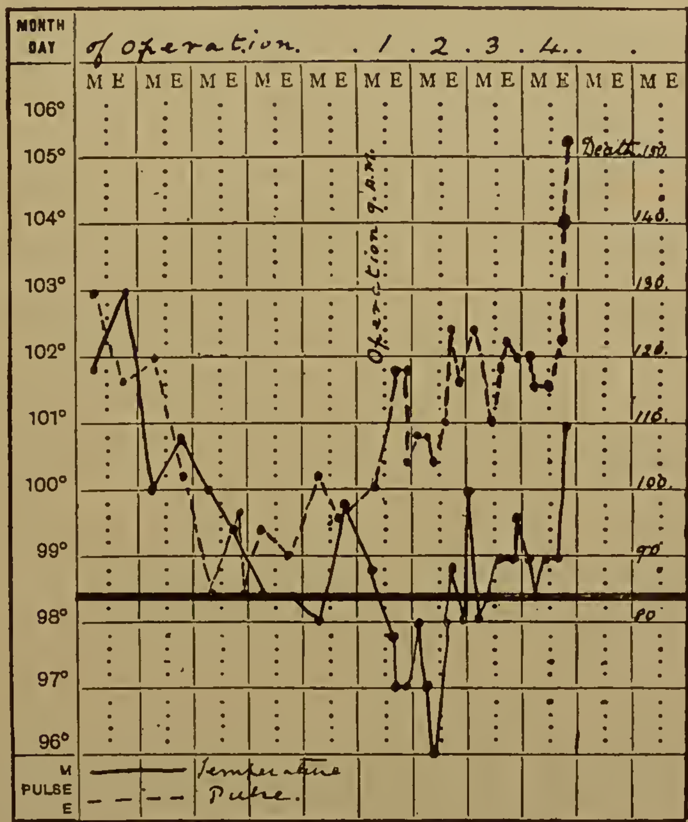

FIG. 97.—Chart showing Fall in Temperature after Operation for Double Pyosalpinx ; Death from Peritonitis on the Fourth Day.

the incision—but on one or more antecedent states. In the simple operation the event begins to exist immediately previous to the effect, while in the more elaborate operations the antecedent states may have pre-existed for an indefinite time. In the simple case the conditions that were necessary for the first production of the phenomena are probably not necessary for its continuance; in the complex operation the phenomena may be produced from day to day on account of the persistence of the agencies which produced them at first.

Lastly, the interpretation of the component parts of these

charts must be often a matter of surmise, but we must always have before our mind such factors as shock, fermentation fever, septic intoxication, septic infection, and hæmorrhage; and we should from time to time attempt the interpretation of particular charts by others derived from operations in other regions of the body.

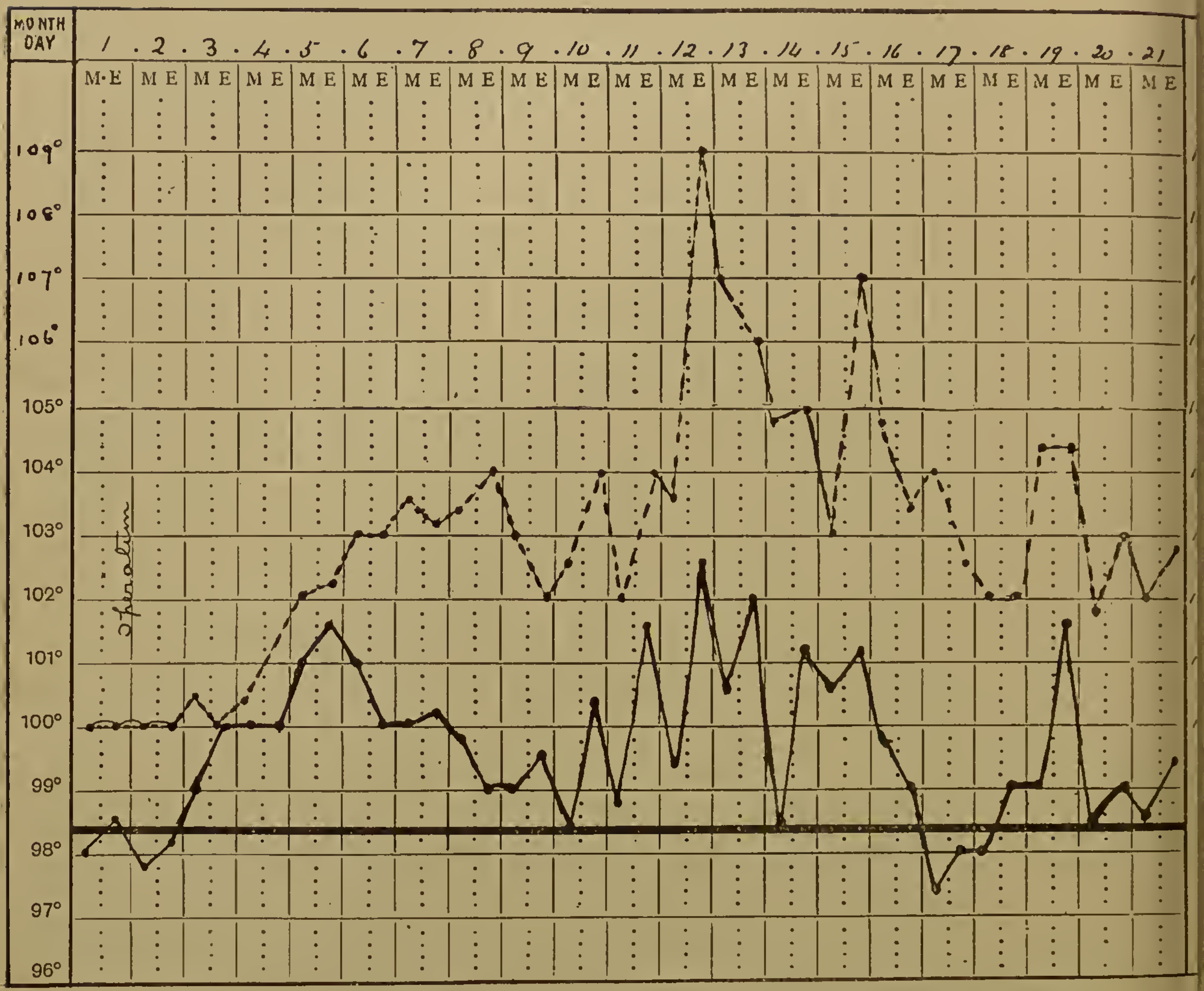

Fig. 98.—Chart after Hysterectomy for Myoma, showing High Pulse-rate.

This case was operated on by Macnaughton-Jones, and made 'an admirable recovery without pain, vomiting, or nausea.'

1st Division.—In this group are placed all cases where we have performed a simple section, such as the removal of a small non-adherent ovarian cyst or a hydrosalpinx. We disturb the intestines only to a slight degree, and the operation is completed in from ten to fifteen minutes; there is no loss of blood and no shock. On the evening of the operation we see a rise in

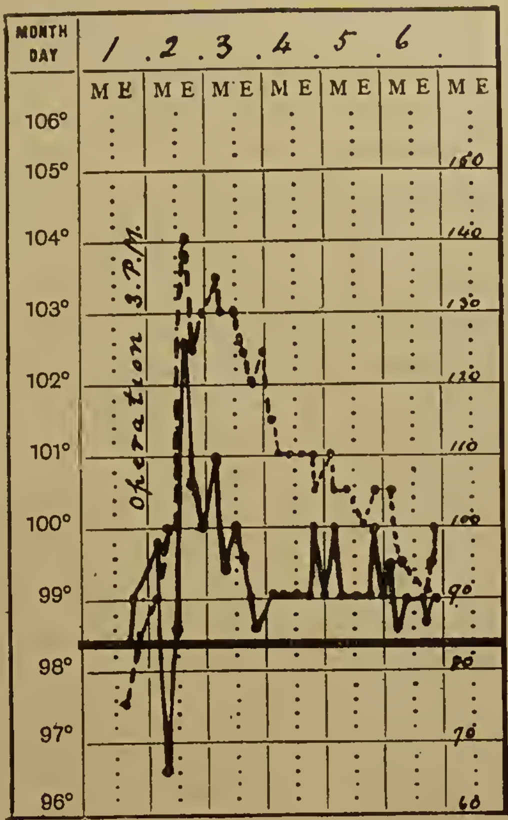

FIG. 99.—Chart of a Case after Hepatectomy; Sudden Rise of Pulse and Temperature during Great Pain on the Second Day after the Operation; Recovery.

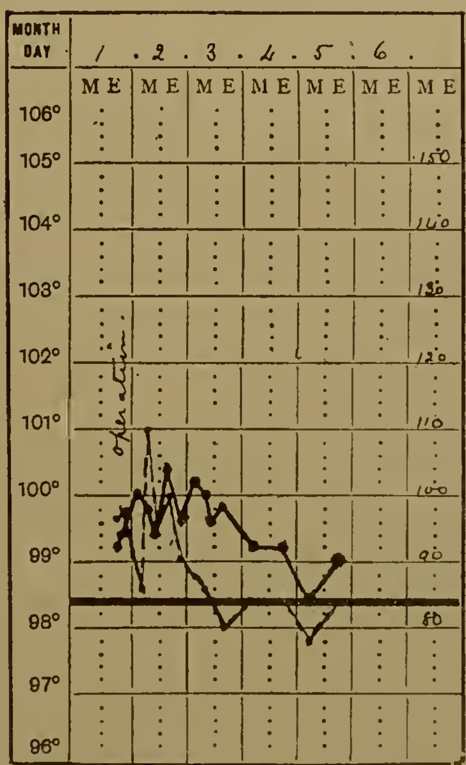

FIG. 100—Chart showing the Temperature and Pulse Curves after Hysteropexy; Recovery.

temperature, and usually a slight increase in the pulse-rate; though occasionally the pulse-rate does not increase—it may even be a little less than before the operation.

The temperature in these cases rises to 100° F. during the first twenty-four hours, and begins to fall again at the end of forty hours, coming to the normal on the fourth day, the day of the operation being taken as the first day.

The pulse-rate almost invariably rises with the temperature, and reaches 95 or 100 pulsations; and when the temperature

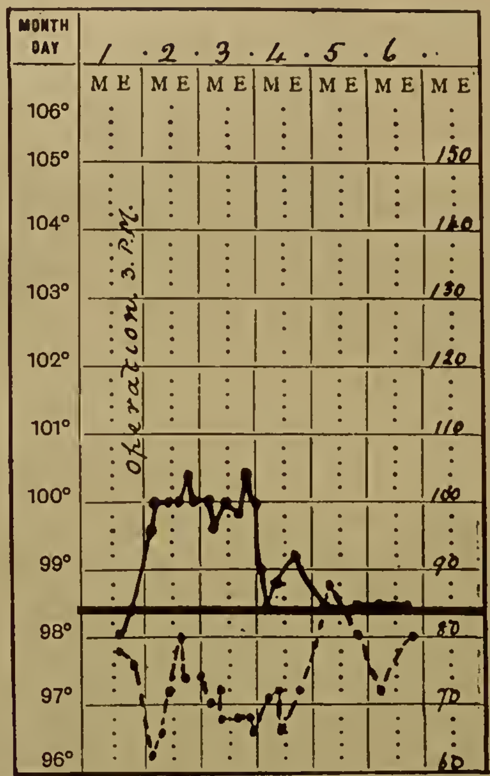

Fig. 101.—Chart of a Case after Removal of Small Dermoid Tumour of the Ovary; Recovery.

begins to fall, or even before that, the pulse quickly comes back to the normal again. The character of the pulse is not altered, it is merely accelerated; but occasionally it does not increase in rate, it may even become slower.

We may look upon this simple chart, which shows an increase of 10 pulsations to every extra degree of heat, as the standard to which all other charts may be compared.

The cause of this increase, both of the pulse and temperature, is a matter of surmise. It is probable that it is due to the absorption of nucleins and albumoses, set free by the destruc-

tion of the tissues and the liberation of blood during the course of the operation.

While this chart is the characteristic one for simple operations, it not infrequently happens that we get a similar chart after the removal of large fibroids—even when the operation has lasted for a few hours.

2nd Division.—In this division will come the largest number of charts after section cases, for this division embraces the charts of the cases from which adherent tubes and fibroid tumours are removed, and also cases operated on for ruptured ectopic gestation.

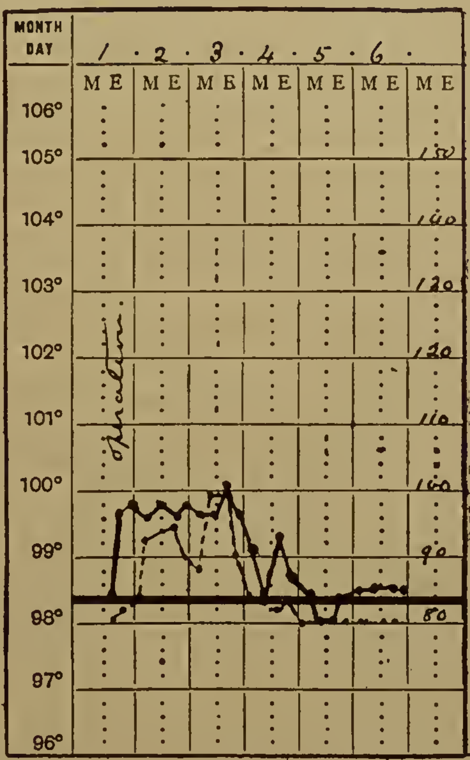

Fig. 102.—Chart of a Case after Panhysterectomy for Fibroid weighing 18 pounds; Recovery.

The tissues in many of these cases do not contain any septic germs, or if they do these do not escape, but owing to the fact that the operations are often very prolonged, and there is much manipulation within the peritoneal cavity, we find that in the majority of these cases the temperature rises beyond 100° F., and the pulse increases in the less serious cases to 110, and in the gravest cases to 130 or 153, or even more.

The chart in these cases is modified during the first twenty-four hours by the amount of blood lost at the operation or afterwards, and by the presence of shock.

We shall examine the charts in their order of seriousness.

After hystero-myomectomy the temperature usually rises to 101° F., while the pulse varies between 100 and 110. The temperature remains above 100° for four or five days, then falls, and the pulse-rate decreases so that the normal is reached by the end of the first week. Chart 103 is a typical one after the removal of a large fibroid, while chart 104 is a composite one of thirty-five cases of total abdominal hysterectomy compiled by Roy Brown.*

One would think that the removal of a large fibroid would be

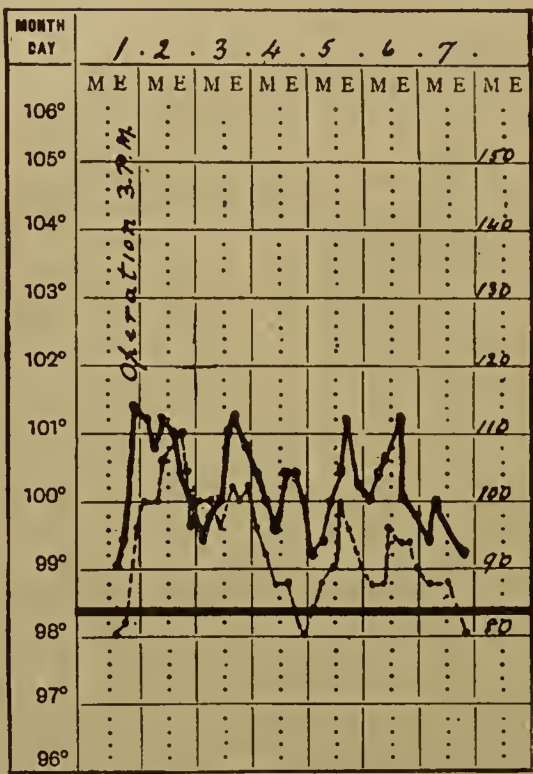

FIG. 103.—Chart of a Case after Hysteromyomectomy ; Recovery.

followed by a considerable increase in the pulse-rate, for the large incision that we must make in order to deliver such tumours predisposes to shock by allowing radiation to take place from the abdominal viscera.

If, however, after lifting the tumour out of the peritoneal cavity we take the precaution to pack in a number of hot gauze towels, so as to prevent the intestines from cooling, we shall find that in many cases the patient leaves the table with scarcely any signs of shock, and consequently the pulse may never

* *American Journal of Obstetrics*, December, 1901.

rise above 100, and we obtain such a chart as we see in Fig. 102.

After operations on cases of ectopic pregnancy, where the tube has been ruptured and there has been some escape of blood into the peritoneal cavity, wherein it has remained for a week or so, we shall find after the operation that the temperature line is not dissimilar to the temperature line that we get after hystero-myomectomy. The pulse-rate, however, is not infrequently somewhat higher. As a matter of fact, it is frequently 100 or

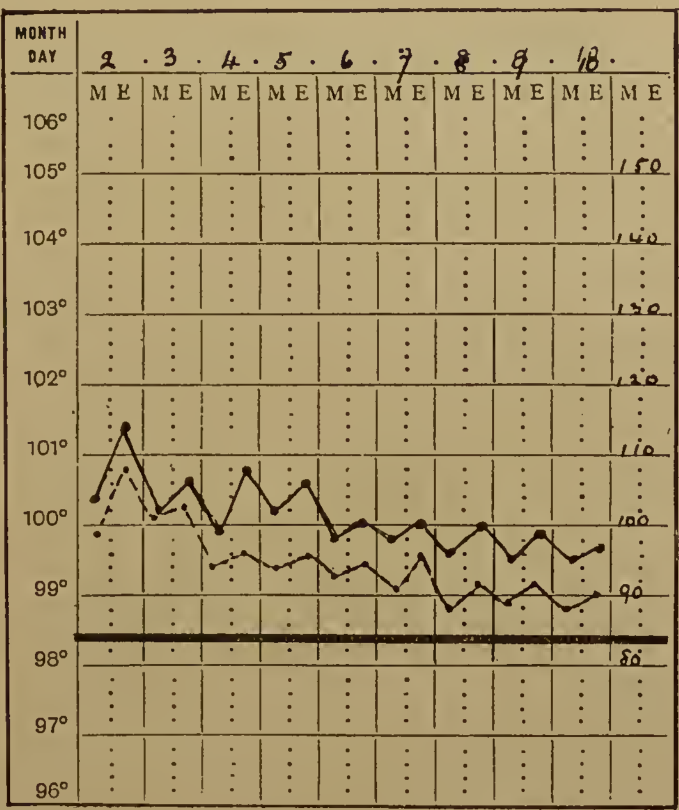

FIG. 104.—Composite Temperature and Pulse Curves of Thirty-five Cases of Total Abdominal Hysterectomies (Roy Brown).

more before the operation, either because the patient has not recovered from the intraperitoneal loss of blood, or because the presence of the blood in the peritoneal cavity causes a local peritonitis, and, lastly, such collection of blood after a time frequently becomes infected from the bowel, and at the time of the operation the manipulation creates raw surfaces which allow of absorption; the temperature, therefore, in some of these cases in our opinion is due to an intoxication which ceases when the channels again become blocked. We have noticed that if the denuded areas are swabbed with peroxide of hydrogen the

temperature is higher than if the parts are merely washed with saline solution; the peroxide facilitates absorption by its power of dissolving the barriers formed in the bloodvessels and lymphatics.

When we come to examine the charts of cases where we have taken a few hours to remove adherent tubes, we shall find that the majority of them present a more serious aspect than the charts of those after the operations on fibroids or gravid tubes. The temperature varies from 101° to 102 °F., and the pulse-rate

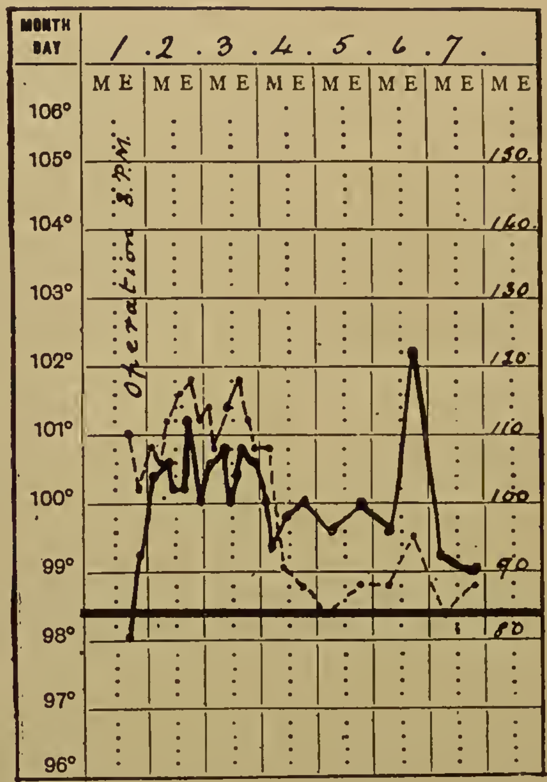

FIG. 105.—Chart of a Case operated on for Extra-uterine Pregnancy; Recovery.

for the first two days is quite commonly 130 from shock, or from what we have described elsewhere as continued shock, added to a certain amount of local peritonitis.

In these cases tympanites is always a prominent feature, and the mere presence of large quantities of gas in the intestine is always accompanied by an increased pulse-rate after a section, and the fall in the temperature curve and in the pulse-rate on the third day that is noticed in many of these charts takes place after the bowels have acted and flatus has been expelled in quantity.

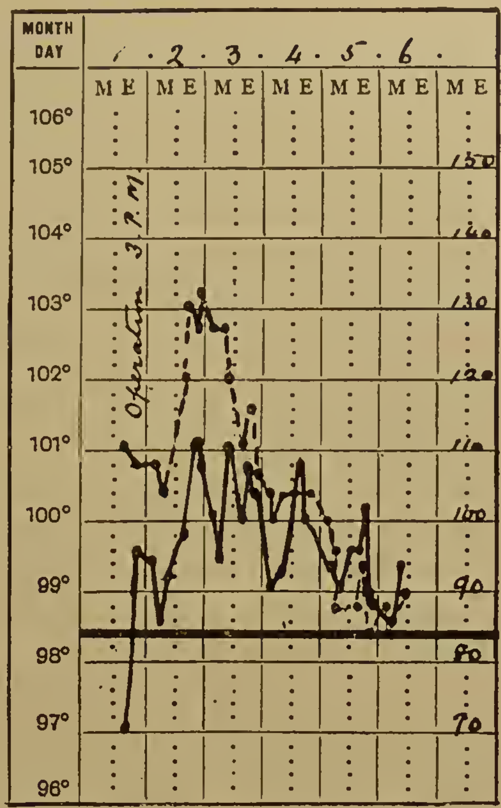

FIG. 106.—Chart of a Case after Removal of Fallopian Tubes for Salpingitis; Recovery.

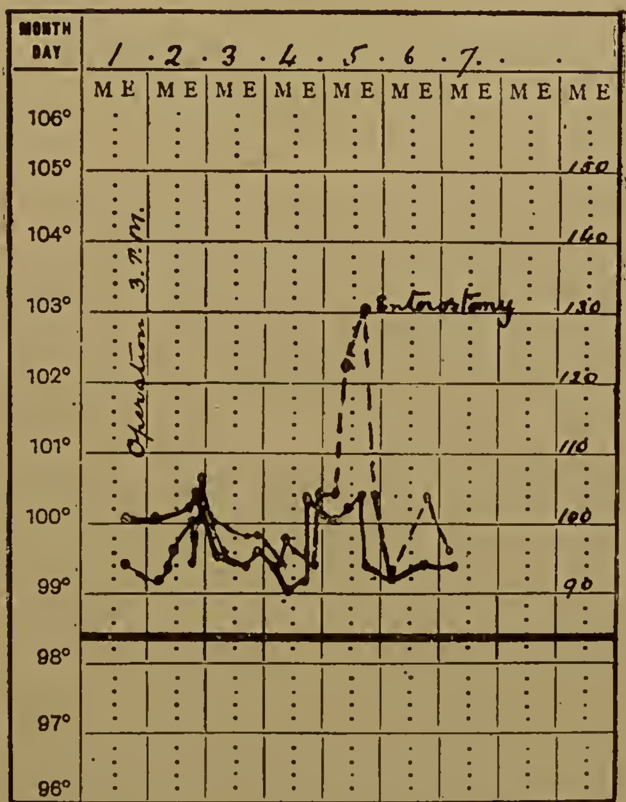

FIG. 107.—Chart after Exploratory Section; Malignant Disease of the First Part of Rectum.

The chart shows the decrease in pulse-rate after opening the sigmoid on the fifth day.

This sudden fall in pulse-rate is well shown in Fig. 107, where the sigmoid was attached to the lower part of the median incision in a case where, while removing a diseased ovary, it was found that the upper part of the rectum was almost occluded by a malignant growth. On the fifth day after the operation the patient became greatly distended with gas, and this could not be passed; the bowel fixed in the incision was therefore opened, and immediately large quantities of gas escaped, and the pulse-rate rapidly fell.

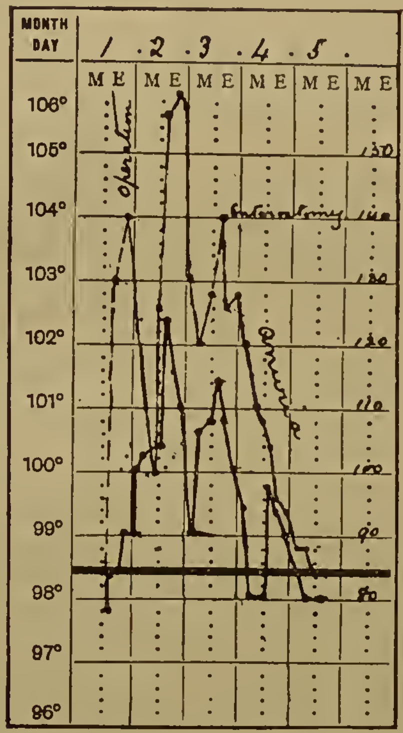

FIG. 108.—Chart after Removal of Appendages and the Appendix; Peritonitis; Enterostomy on the Third Day; Anuria for Thirty-six Hours before Death.

A sudden fall in the pulse-rate is seen in Fig. 108 after enterostomy.

Sometimes after severe operations, where there has been prolonged manipulation, the temperature and pulse curves rise during the first thirty hours to an alarming height; this is well shown in Figs. 99, 108-113.

Chart 109 was from a case of pyosalpinx, and the operation lasted two hours. Some of the pus escaped during the removal of the tubes. As there was considerable oozing we inserted some iodoform gauze. The patient next day looked very ill, her face was flushed, her breathing was shallow and quick, and she looked as though she were suffering from virulent peritonitis.

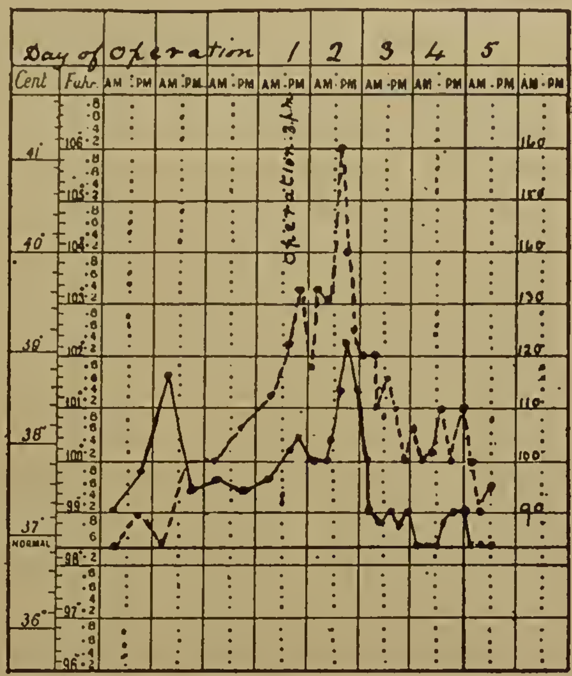

FIG. 109.—High Pulse-rate after Removal of Double Pyosalpinx; Recovery.

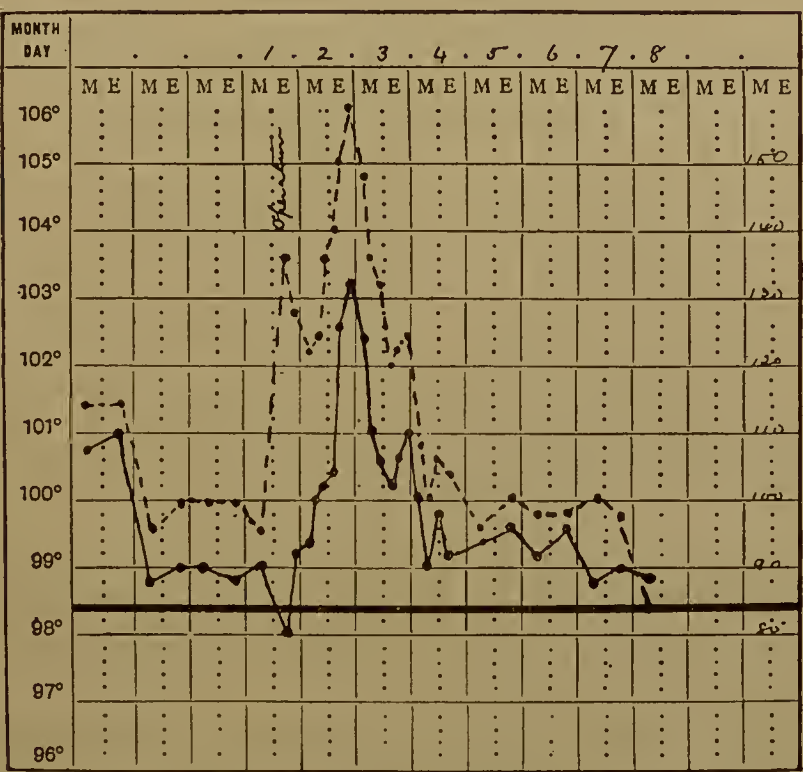

FIG. 110.—High Pulse-rate after Removal of Ruptured Ectopic Pregnancy; Recovery.

Case operated on by Dr. Barrington.

The gauze was removed, and it looked perfectly normal, and there was no hæmorrhage. The bowels acted soon afterwards, and the patient continued to improve from that time onwards, and presented no sign of sepsis.

The second case was operated on by one of my colleagues. The case was one of ruptured tubal pregnancy, in which there was a large amount of blood-clot in the peritoneal cavity. The rupture had taken place some weeks previous to the operation. The pulse-rate in this case rapidly increased, and the patient

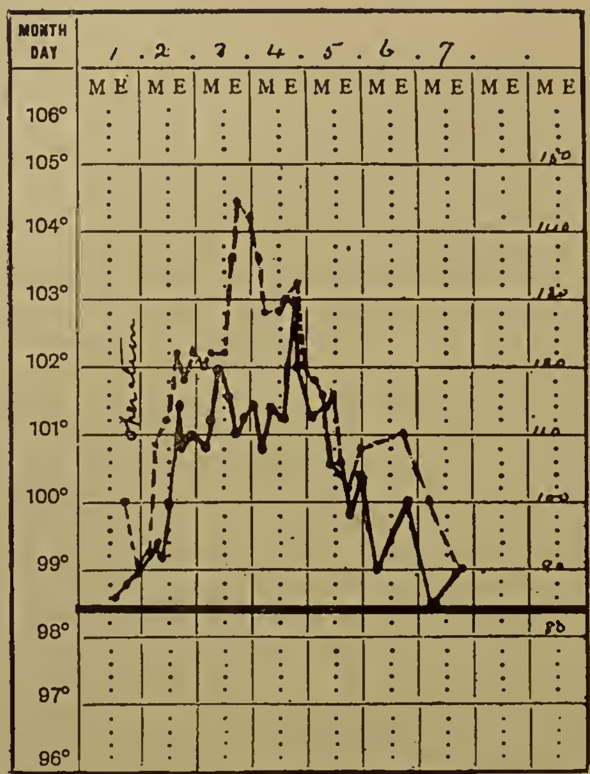

Fig. 111.—High Pulse-rate after Removal of Double Pyosalpinx; Recovery. Case operated on by Dr. Barrington.

looked feverish and septic. In this case the bowels acted quite easily, but the pulse did not fall after this, but rose still higher. The patient, however, recovered without any further unfavourable symptoms.

Chart 112 is another instance of the same peculiar rise. This patient made then an uninterrupted recovery.

We were inclined to regard these cases as instances of septic intoxication, but having occasion to remove a sarcoma of the shoulder-joint by the interscapulo-thoracic amputation, a similar temperature and pulse curve was noted; the pulse, in fact, rose

to 190 twelve hours after the operation and the temperature to 103°. The wound, however, healed by first intention. We can only suggest that these cases are due to some form of reaction after shock; this view appears to be borne out by a third chart, which we have obtained from a colleague, where there was most marked shock immediately after an operation for double pyosalpinx. This is well shown by the fall of the temperature to 97° and the rise of the pulse to 134. We saw the case twenty-four hours after the operation, and advised a large submammary

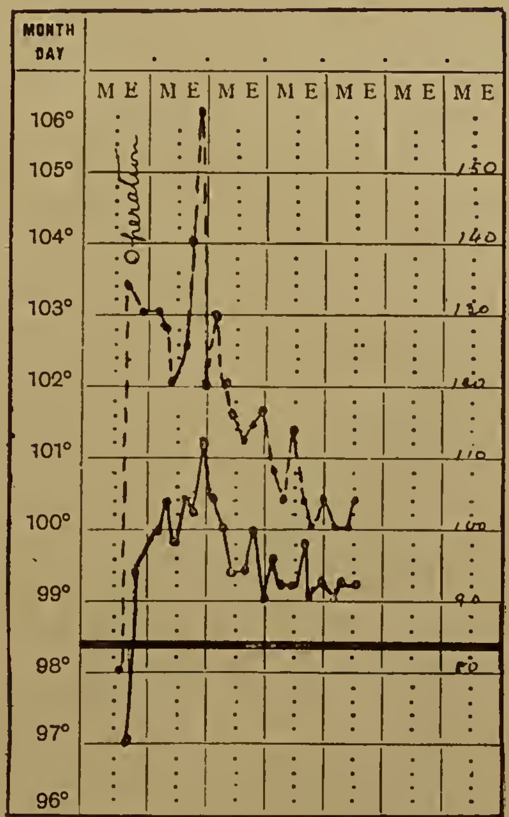

Fig. 112.—High Pulse-rate after Removal of Double Pyosalpinx; Recovery. Case operated on by Dr. Cope.

transfusion, after which the pulse-rate fell and the patient progressed favourably. We class such a case as one of continued shock.

Whenever the shock is well marked, or when much blood is lost, we may always expect to find that the temperature will fall towards or below normal. The fall in the temperature takes place not only in patients whose temperature is normal at the time of the operation, but also in those who may have considerable fever. With this fall in temperature we have a sharp rise

in the pulse-rate, and with well-marked shock the pulse-rate is usually 130 or more.

In many instances the patient's pulse remains rapid from the time of the operation, and, instead of decreasing, after twelve or eighteen hours it increases. The temperature may rise for a time, but as the pulse becomes faster and faster the temperature remains stationary or falls. These are instances of what we

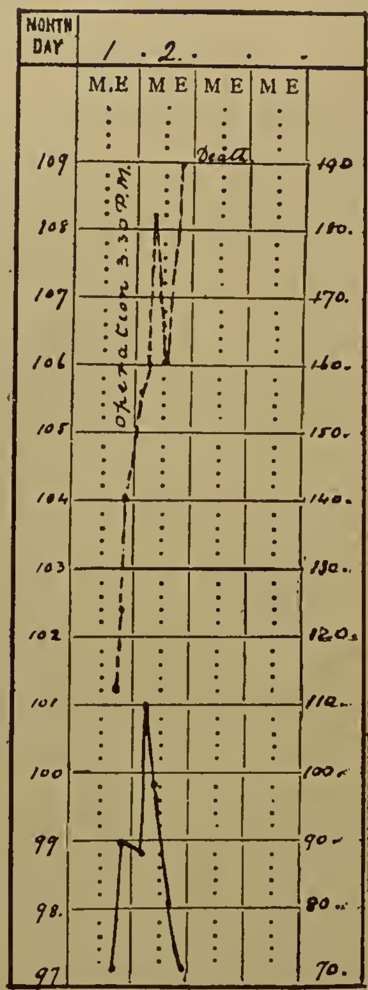

FIG. 113.—Chart of a Case after removing very adherent Sterile Pus-tubes. Chart shows continued shock; there was no secondary hæmorrhage; death.

have in another paragraph described as **continued shock.** Chart 113 belonged to a young woman operated on by one of my colleagues. She had very adherent appendages, and these were removed. We saw her eighteen hours after the operation; she was lying quietly in bed, and, beyond the excessively rapid pulse, exhibited no symptoms that would cause alarm. She died six hours later, and the autopsy showed that

there had been no hæmorrhage, and there were no signs of infection.

Whenever we note a rising pulse with a falling temperature —and this occurs during the first few days—we must always think of secondary hæmorrhage, primary, continued, or secondary shock, pulmonary embolism, or collapse at the approach of death.

Very rarely we may get death from shock when the pulse and

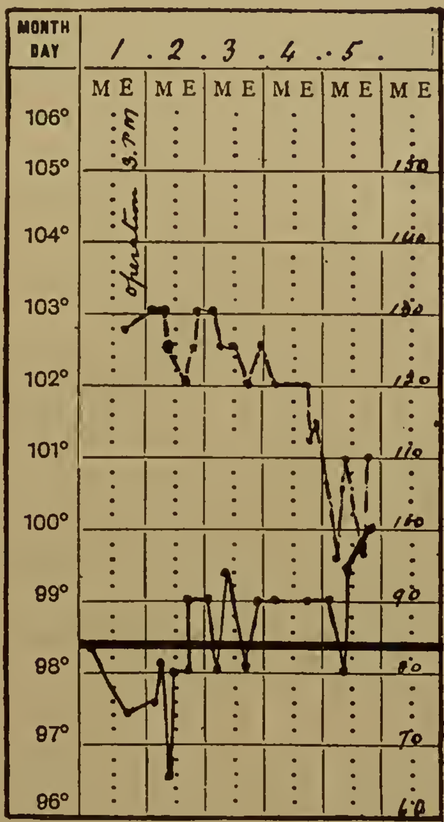

Fig. 114.—Chart of a Case after separating the Right Fallopian Tube from the Sigmoid and Appendix.

The fall in the temperature on the first day is due to shock, and on the second day to hæmorrhage ; the rise on the fifth day is due to suppuration of the wound ; recovery.

temperature are normal. Chart 116 was an instance of this. The operation had been a very prolonged one for double pyosalpinx ; the patient exhibited all the symptoms and signs of shock, except that the pulse was not rapid. She died fourteen hours after the operation. . . . Perhaps her condition would be better described as one of collapse. This was one of the two patients we lost in our first fifty sections, and at that time we did not practise submammary transfusion.

In case of late shock the patient may apparently have

recovered from the effects of the operation, and the pulse and temperature may be normal. Then, after twenty-four hours, the pulse is found to rise up to 140 or 150, the patient becomes blanched, but she does not exhibit any of the typical signs of secondary hæmorrhage. The pulse in such cases often takes days before it again regains its normal rate. No doubt some of these cases are really due to hæmorrhage, which continues for a time and then ceases, and the blood is absorbed.

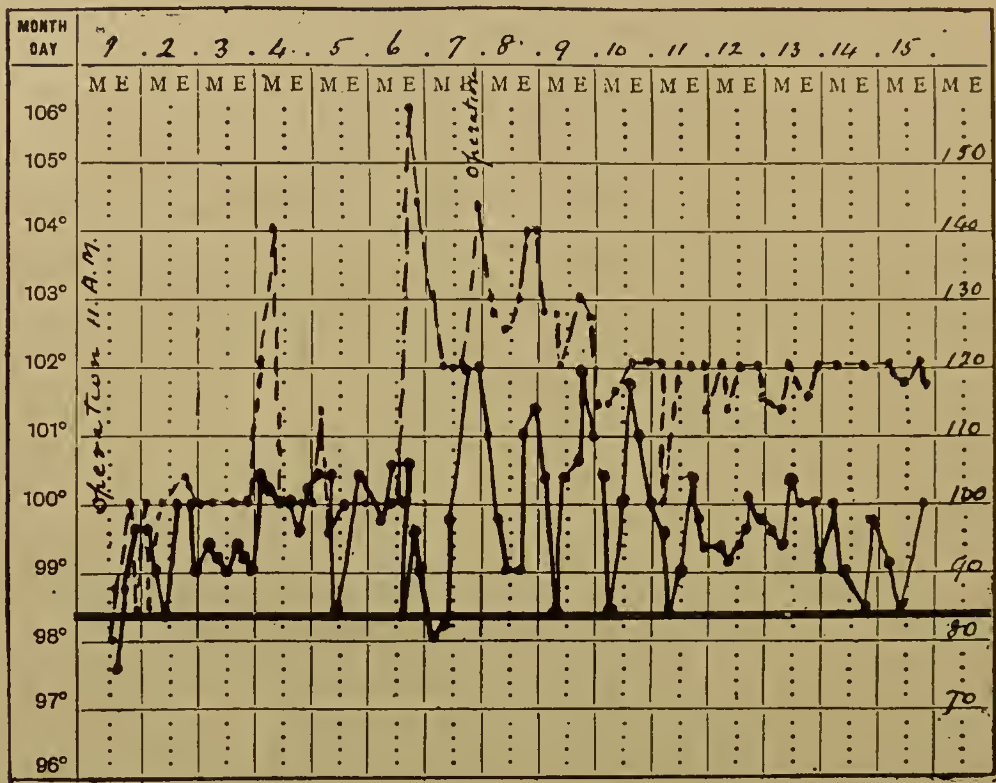

Fig. 115.—Chart of a Case after Hystero-myomectomy.

The sudden rise in the pulse-rate on the sixth day was due to pulmonary embolism; on the seventh day the cervix was removed by a vaginal section; the temperature in the mouth on the sixth day fell to 93° F.; the temperature in the axilla was normal; the case was septic from the outset; recovery.

3rd Division.—As the result of septic infection at the time of the operation, or soon afterwards, we get a series of charts which we place under this division.

In the great majority of instances when septic intoxication and septic infection occur after a section for septic conditions connected with the uterus, tubes, ovaries, or broad ligaments, there is a marked increase in the pulse-rate and a decided rise in the temperature. No one denies that peritonitis may exist with practically a normal pulse and temperature, but these instances

are exceptional,* and do not invalidate this rule, that most frequently with post-operative peritonitis arising from infection of the pelvic organs in women there is a marked increase in the pulse-rate, and a decided, and at times a very marked, increase in the temperature. In some cases, unfortunately, the peritonitis may advance considerably before it makes a marked impression on the pulse or temperature.

If the infection be very virulent, the patient is overwhelmed,

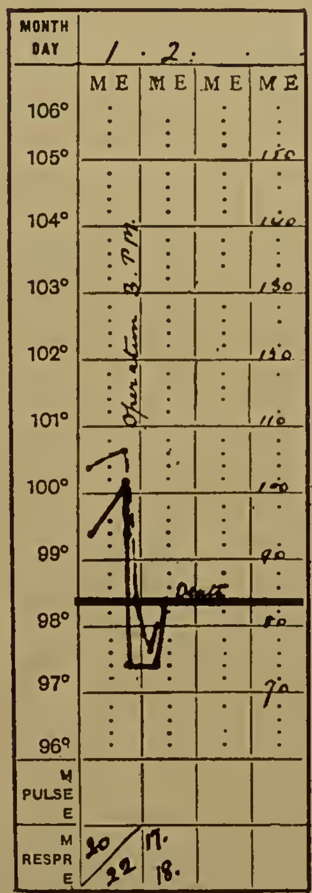

FIG. 116.—Chart showing Shock, after Removal of Pus-tubes, with Normal Pulse and Temperature; Death.

and looks as though she were suffering from shock or from secondary hæmorrhage. In such cases the temperature does not rise to a great height at first (101° F.), but the pulse quickly increases to 120 or 130, becoming usually very irregular. As the infection advances the temperature rises to 104°, and the pulse becomes very small, weak, and compressible as death approaches.

* The cases that linger on until the second week and die from the eighth to the twelfth day not infrequently exhibit a low temperature.

In some cases of fulminating peritonitis the thermometer may not register higher than 101° F. in the mouth, but if the temperature be taken in the rectum, we may find that it is 105° F. We on one occasion ran a thermometer through the abdominal incision two hours after a patient had expired from peritonitis after a section, and found that it registered three degrees higher than the last observation before death. But though the temperature may not be strikingly high in such cases, the pulse will be found excessively rapid.

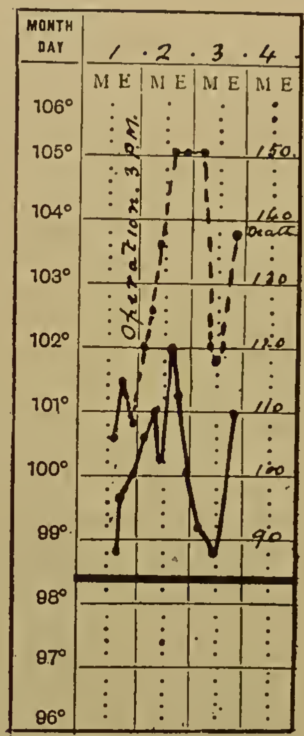

Fig. 117.—Chart of a Case after Hystero-myomectomy complicated with Pus-tubes.

The chart shows the apparently favourable fall in the pulse and temperature after the bowels had acted ; death, however, eight hours later.

These forms of fulminating peritonitis are, however, very uncommon; usually a patient who develops septic peritonitis lives until the fourth or fifth day.

The pulse or temperature may be normal or but slightly raised on the first day; but if the micro-organisms multiply rapidly, we get a rising temperature and pulse after the first twelve hours. The pulse may fluctuate somewhat, but it does not return to normal, but gradually increases to 130 and 140, and as the end approaches it shoots up twenty pulsations, reaching 160, or even more.

It is urged that the temperature chart is of little use either as a means of gauging the severity of the peritonitis or in forming a prognosis. This arises from the fact that many observers start with the assumption that the height of the temperature curve is in direct ratio to the severity of the peritonitis. If, however, we recognise the fact that advanced peritonitis does co-exist with a low temperature, then the recognition of this inverse ratio between the severity of the disease and the height

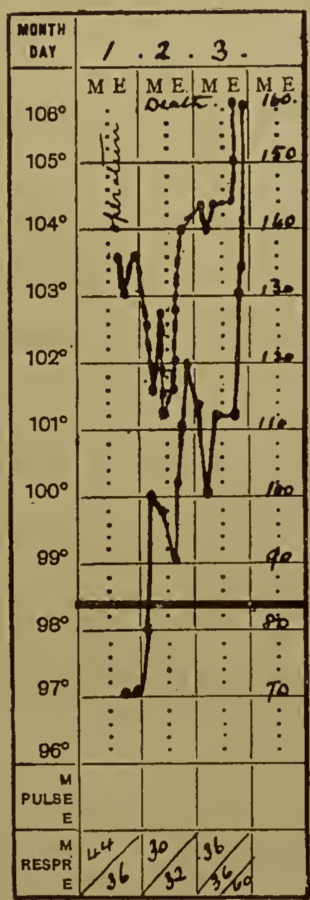

FIG. 118.—Chart of a Case after Removal of Pus-tubes; Death from Septic Peritonitis.

of the temperature curve becomes at once a great assistance to us.

That there should be no common standard of fever, no type of temperature, characteristic of peritonitis is not, indeed, a matter of surprise when we remember that the term 'peritonitis' is used to embrace a considerable number of morbid sequences, the causes of which are infinite, and consequently we must expect a variety of charts. In fact, the peritoneum is the only field where these varied and numerous causes develop and

generate, and while there may be uniformity of succession when the causes of the phenomena are identical, it is not, indeed, surprising that different causes—such as, for instance, different varieties of micro-organisms—should not produce invariable sequences in individuals whose resisting powers vary so widely.

We can therefore readily agree with Wunderlich when he says, in speaking of temperatures in inflammation of the serous membranes of the chest and abdomen, that they exhibit in the great majority of cases perfect absence of any typical character;

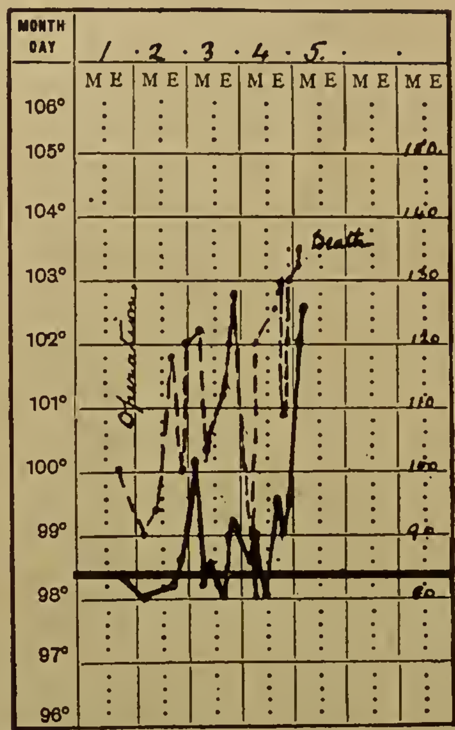

Fig. 119.—Chart after Section for Double Pyosalpinx; Peritonitis; Death.

and there is no course of the temperature in these affections which can be regarded as denoting safety—whatever the course of the temperature, a fatal termination may ensue. No behaviour of the temperature guarantees that the disease will end in perfect recovery.

Now, while the general surgeon has no standard of fever, no type of temperature to refer to in his many clinical varieties of peritonitis, the surgeon accustomed to operate on the pelvic organs is brought face to face after his operation with peritonitis, whose origin is to-day limited to a few species of micro-organisms; and therefore, since the cause is limited, the results, as expressed

by the symptoms, are fairly characteristic, and we can in many instances form an accurate estimate of the severity of the disease, and give a prognosis from the behaviour of the temperature and the pulse after the operation.

The temperature in peritonitis is more inclined to fluctuations

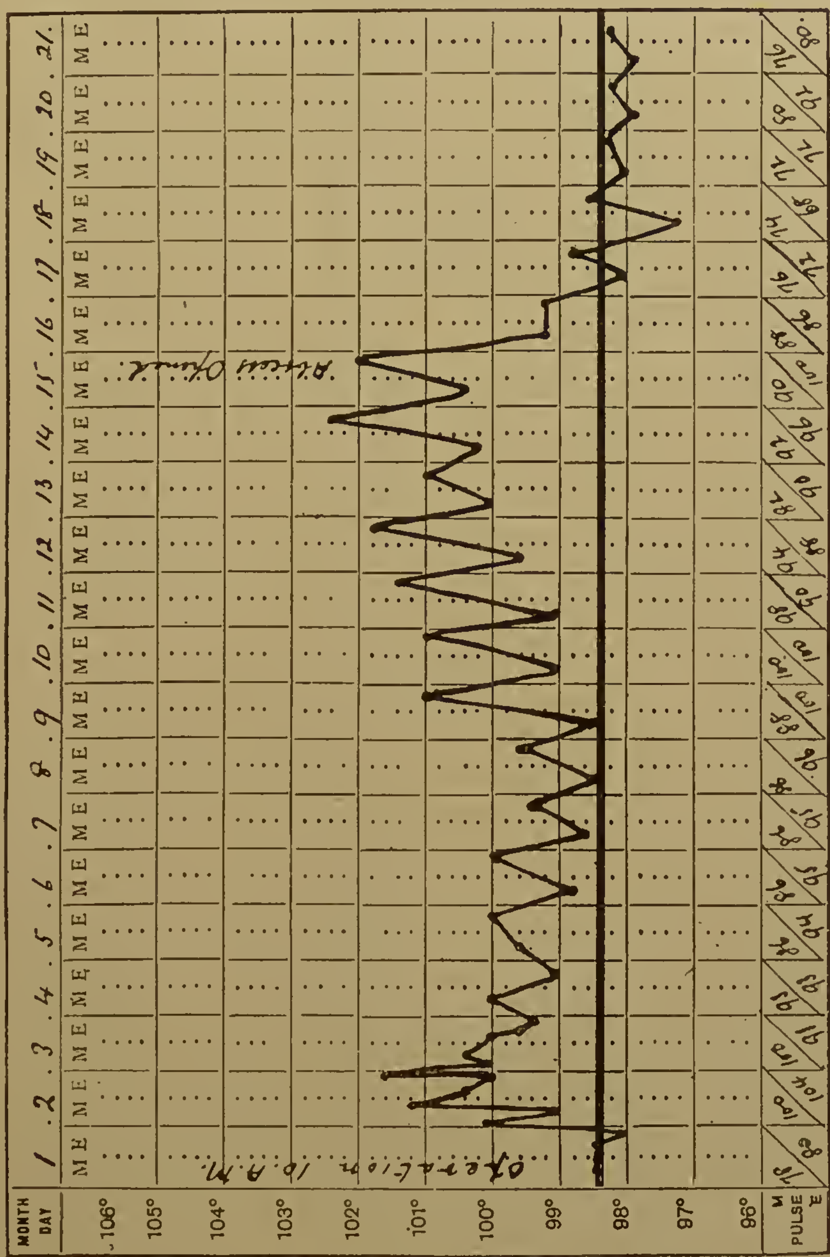

Fig. 120.—Chart of a Case after Operation for Ventral Hernia.

The rise in temperature on the ninth day is due to deep suppuration of the wound, caused by infected catgut; the wound was opened on the fifteenth day, and the pus liberated; the catgut used infected two other cases in a similar manner; recovery.

than the pulse, and consequently we may have it returning from time to time towards the normal. A deceptive fall is seen in Chart 117 following an action of the bowels.

In other cases it rises steadily, increasing day by day. In nearly all cases as the end approaches the temperature shoots up, and may rise to 103° F., even to 107° F..

Chart 118 shows this steady rise from the first after the preliminary drop from shock. The patient had large adherent pus-tubes that ruptured when they were being removed.

Chart 119 is an instance where the temperature would deceive

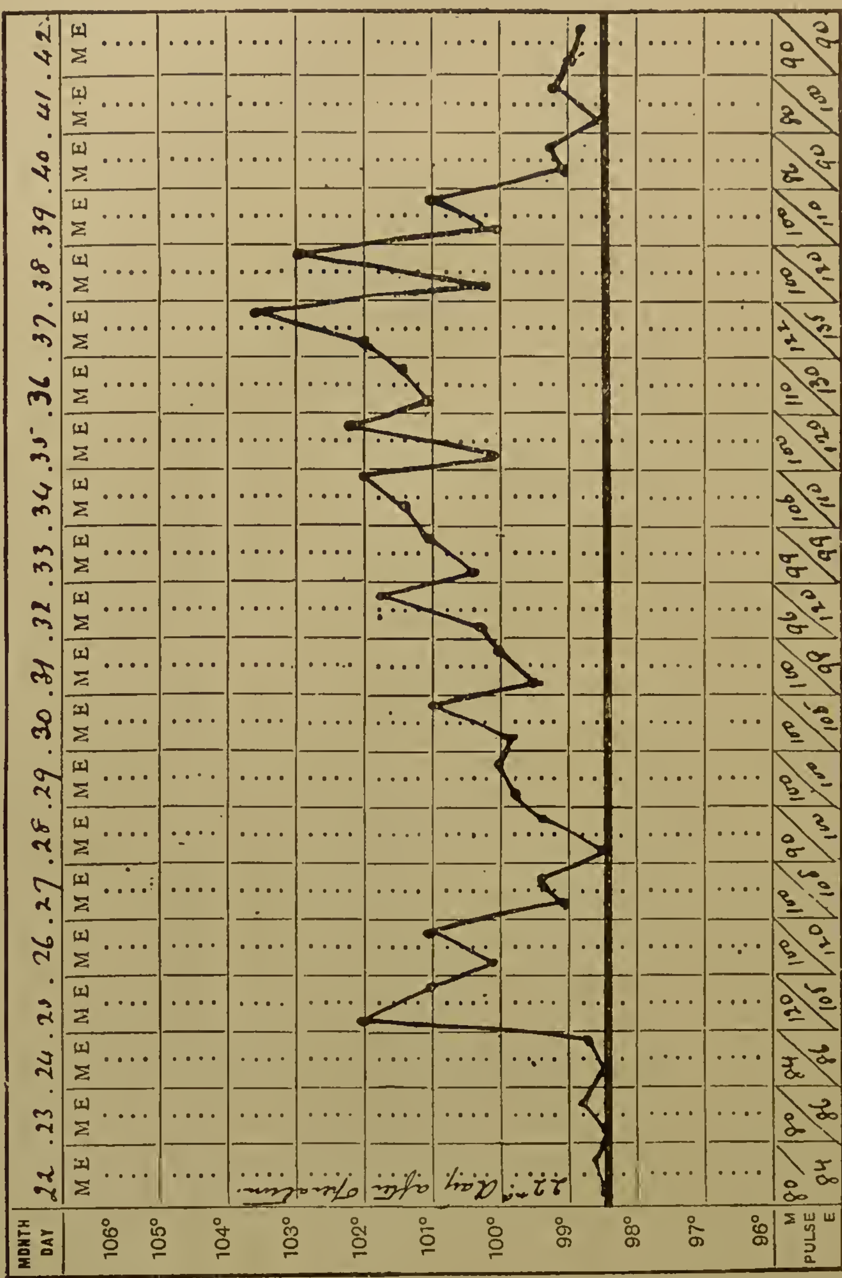

FIG. 121.—Chart showing the Rise of Temperature, on the Twenty-fifth Day after a Section, due to the Development of an Extraperitoneal Hæmatocele, which suppurated and burst into the Vagina on the Thirty-seventh Day after the Operation ; Recovery.

one, although the pulse-rate would warn us of danger. This case was one of pyosalpinx from acute gonorrhœa.

Chart 97 was supplied by a colleague. The case was one of large distended pus-tubes that could not be removed. The patient exhibited after the operation symptoms of profound

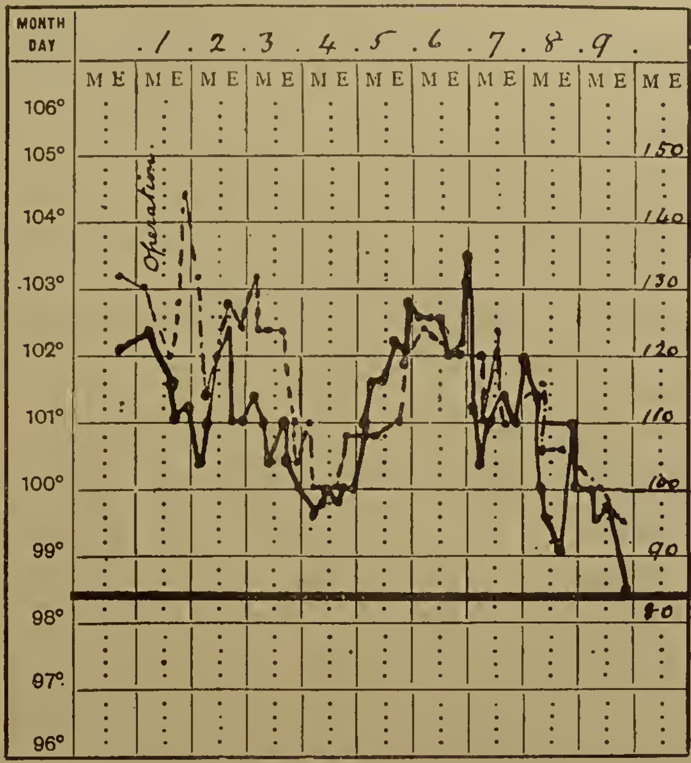

FIG. 122.—Chart of a Case after Removal of the Appendix from a Case of Acute Ulcerative Appendicitis ; Recovery.

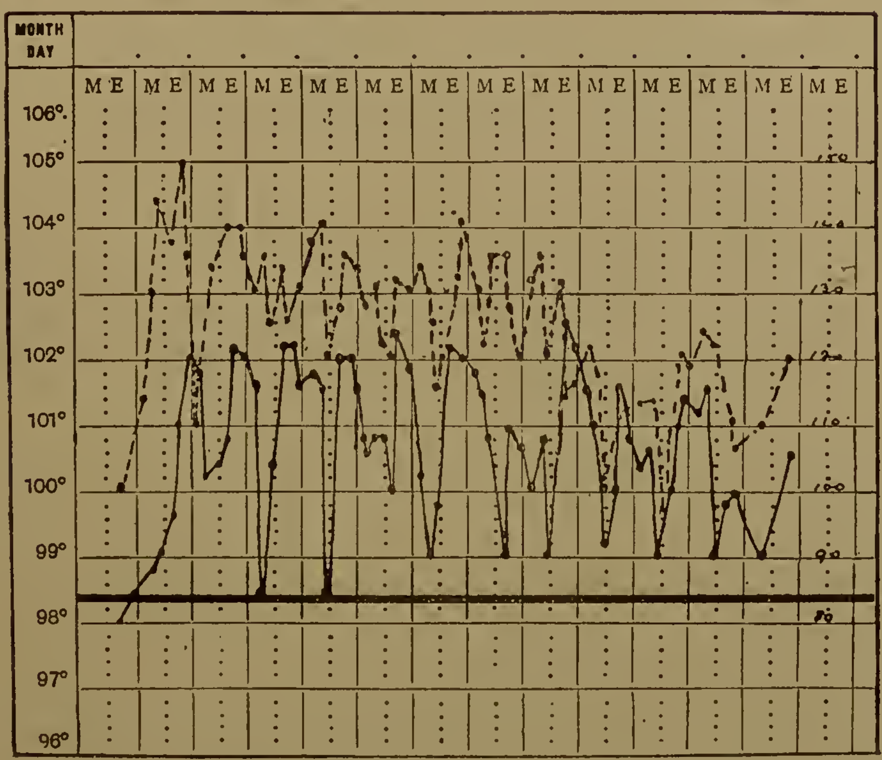

FIG. 123.—Chart after Abdominal Section for Calcified Hydatid Cyst of the Abdomen and Vaginal Section for Hydatid Cyst situated in the Pouch of Douglas ; Recovery.

shock, from which she apparently recovered. On the evening of the fourth day she suddenly exhibited alarming symptoms and died, but not, however, before it was ascertained that she had purulent peritonitis.

One of the most alarming rises in temperature (105·5° F.) and pulse-rate may be met with after operating on a pelvic abscess, even though no living micro-organisms may be present in the pus. Such alarming rises are due to septic intoxication. After the sudden rise there is usually a fall, almost as sudden.

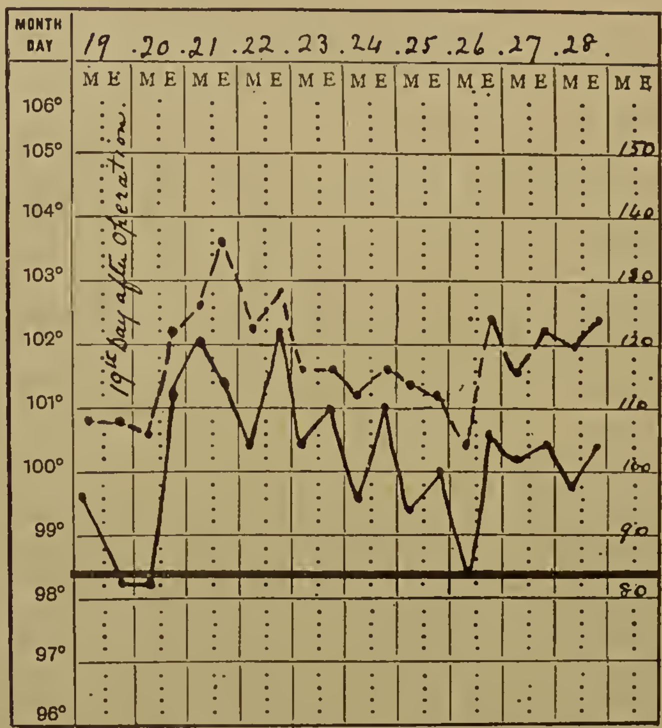

FIG. 124.—Chart of a Case after Hystero-myomectomy.

The rise in temperature on the twentieth day after operation is due to thrombo-phlebitis ; recovery.

With septic intoxication and septicæmia the charts present many variations.

In some cases the chart may present nothing unusual; then towards the end of the first week the pulse is found to be somewhat increased in rate during the evening, and at the same time there is a small evening rise in temperature. The pulse does not go above 100, but the temperature may gradually creep up day after day. If now the pus is liberated the temperature immediately falls to normal or below, since the absorption of toxins has ceased suddenly.

Occasionally the pulse and temperature may have been normal for days or even weeks, when suddenly we find a sudden rise in both. This may be due to the formation of an extraperitoneal hæmatocele. After a few days the temperature and pulse come down, and if all goes well remain down. If, however, the blood-clot becomes infected, we have a gradual rise evening after evening until the pus is evacuated.

With septicæmia we may have a rapid fall in the pulse-rate and temperature if an abscess is opened and evacuated during

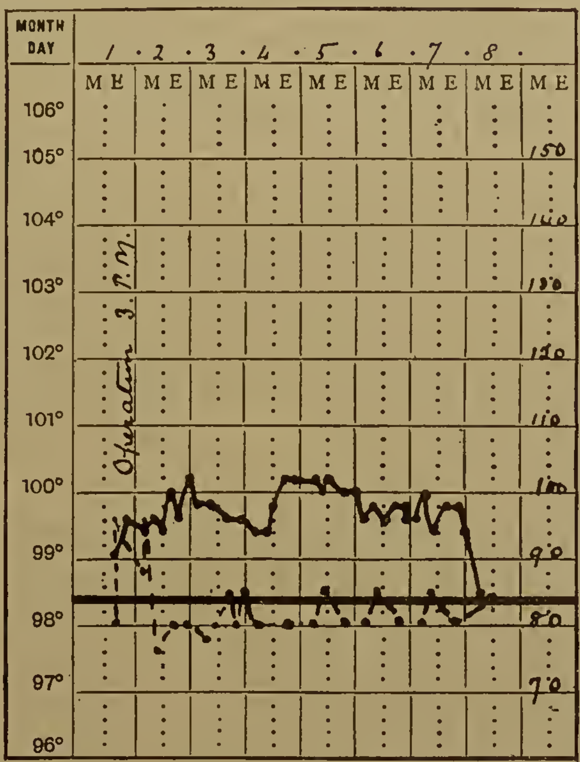

FIG. 125.—Chart of a Case after Removing Pus-tubes.

The pouch of Douglas was filled with gauze on account of tear in rectum; bowels acted on the sixth day.

the course of the operation. This fall goes on for some days; then there is a pause, and we find the pulse and temperature beginning to rise again. This is usually due to the drainage being imperfect.

In a second type of chart we have the pulse and temperature tending to rise day after day after the operation. In these instances the case has been infected at the time of the operation.

Chart 123 is for a young woman who had two hydatid cysts, one about the umbilicus and the other in Douglas's pouch. Both were treated according to Lindermann's operation, and both cysts suppurated most profusely. The patient made a good recovery.

4th Division.—After an operation, no matter how simple, the temperature and pulse may be gradually or suddenly affected by some intercurrent complication.

As examples of this we may allude to suppuration in the wound, extraperitoneal hæmatocele, thrombo-phlebitis, pulmonary embolism, pneumonia, malaria, and influenza. The manner in which these various affections alter the pulse and temperature we shall mention in the paragraphs devoted to each.

Respiration.

The nurse should, as a matter of routine, note the number of respirations per minute when taking the pulse-rate and temperature.

During the first night, if all is going well, the respiratory rate is generally 22.

During the second day, if the pulse-rate increases we shall find that the respiratory rate has increased *pari passu*, even though the temperature may have altered but slightly. Thus, with a pulse of 125 we frequently have a respiratory rate of 26; while with a pulse-rate of 140 and a temperature of 100° F. we may find the respirations 48 per minute.

But the mere respiratory rate is not alone to be observed; we should pay attention to the 'type' of respiration.

Thus, if a day or so after the operation we remove the binder and dressings from a patient who is progressing favourably, we shall observe that the abdomen rises and falls with each inspiration and expiration, and when this is the case we shall find that the hand can be laid on the abdomen without causing the patient to shrink and tighten her abdominal muscles. If, on the other hand, we observe a patient who has developed peritonitis, we shall not see the abdomen rising and falling with inspiration and expiration. On the contrary, the abdominal walls are kept rigid, the type of respiration is changed: it has become 'thoracic.' As the peritonitis develops even the diaphragm is kept at rest lest its movements should cause increased abdominal tension and increase the pain; and it is now that the patient dilates her nostrils at every breath, and raises her arms over her head.

To appreciate this change in type of respiration, we must remember that the lower series of intercostal muscles, which are concerned in the movements of respiration, are supplied by the lower seven dorsal nerves, which also supply the abdominal

muscles—*i.e.*, rectus, two oblique, and transversalis. These lower dorsal nerves send branches of communication through the splanchnics to the solar, cœliac, and superior mesenteric plexus, which in turn supply the abdominal viscera. As soon as the peritoneum covering the abdominal viscera becomes inflamed, the lower series of intercostal muscles and the abdominal muscles are reflexly brought to a condition of rest, so as to ease and guard the inflamed areas.

When peritonitis is well advanced, not only is the type of respiration changed, but the rate is always much increased. Thus in a case of virulent peritonitis the pulse-rate during the second day after the operation was at three o'clock 150, the temperature was 100° F., and the respirations 48. Three hours later, the bowels having acted after an enema had been administered, the pulse-rate fell to 120, the temperature to 99·2° F., and the respirations to 28 per minute. Later on all three increased, and the patient expired.

Even when peritonitis is not present, but the patient is suffering much pain from meteorism, the pulse-rate usually increases to 120 or more, and the respiratory-rate rises to 26 per minute.

When the patient is suffering from severe secondary hæmorrhage the respiration soon becomes quickened and sighing. The patient, if lying on her back, will usually elevate her chin so as to breathe with more ease. If the hæmorrhage still continues the dyspnœa increases, and the patient when she speaks can only do so in gasps; her nostrils dilate, and the accessory respiratory muscles of the neck are used to aid her efforts during her time of air-hunger.

In embolism of the pulmonary artery the patient is seized with sudden dyspnœa, and if lying down will ask to be propped up to relieve the feeling of suffocation. If the case is not immediately fatal, the patient will continue to have great shortness of breath, especially on the slightest exertion. She is compelled to sit up in bed, and often remains thus with her mouth open, the extraordinary muscles of respiration being brought into action in breathing.

CHAPTER XXVI

TREATMENT OF CIRCULATORY COMPLICATIONS

We shall now consider the various drugs which are commonly employed after sections to influence the heart and bloodvessels, and so regulate the pulse.

The young surgeon will not have performed many abdominal operations before he will encounter a case where, after the operation, the patient's pulse-rate will be 120, and the rate during the next twenty-four hours will increase until it may be 150 or even more. In one case, after performing Alexander's operation, although the peritoneal cavity was not actually entered, the patient's pulse rose to 218. She had previously suffered from rheumatic fever and endocarditis.

The study of high pulse-rates is of considerable importance, because in shock, hæmorrhage, and peritonitis a distribution of the blood occurs which causes the heart to act under such disadvantageous conditions that, unless a redistribution of the blood occurs, the patient's life is threatened. We shall study here the treatment of circulatory complications as mėt with in Shock and Hæmorrhage.

Shock.

The majority of surgeons regard a greatly accelerated pulse-rate during the first twenty-four hours after a section as an indication of shock, and this is, as a rule, a true interpretation. We shall accordingly consider the remedies that are used to influence the pulse-rate in such cases.

The circulation is disturbed in proportion to the shock, for the effect of shock is a paralysis of the vaso-motor nerves in the splanchnic area, while at the same time we have a varying degree of paralysis of the whole vaso-motor system.

The outstanding sign is an intensely rapid pulse due to an

abnormal distribution of blood. The problem that is set us is how we are to support the strength of the heart while it is working at its abnormal rate; and, secondly, how we are to bring about a redistribution of the blood.

A heart that is beating more quickly than normal wears itself out sooner than one that is acting slowly; there is a waste of energy, for the katabolism is much greater than the result obtained.

Speaking generally, the rapidity is to be taken as an index denoting the severity of the condition, while the particular character of the pulse indicates the effect of the lesion on the patient's system.

This is true of shock, and we may take the rapidity of the pulse almost as an index to denote the amount of fall in the blood-pressure in the systemic arteries.

Since the force and frequency of the heart's beats depend upon venous pressure, and the pressure of the blood in the vena cava determines the amount of blood sent to the arteries, it comes to pass that when shock is developed we have a lowered venous pressure on the right side of the heart, a greatly accelerated heart-rate, with a diminution in the amount of blood sent to the arteries.

Since the patient with a weak heart is much more affected by shock than one with a sound and efficient organ, we shall suppose that we are dealing, for the present, with a patient whose heart, before the operation, was quite sound and normal. When such a patient suffers from shock the first point to be observed is that the acceleration in the heart-rate is not due to any suddenly-acquired weakness in the heart itself; on the contrary, continued examinations of the heart show us that it has abundant strength and reserve force, and that it is capable of beating within wide limits as regards rate without any very observable changes in the force of its contractions.

It is not, then, the heart that we need be anxious about. Our drugs must be chosen so as to influence the dilated splanchnic vessels, for these are, as Gottlieb says, the regulators of the circulatory mechanism, and our aim is to restore the general arterial tension.

To some it will appear a mere waste of time to endeavour to influence these splanchnic vessels, because they hold that this rapidity of the heart after an operation is but one of the results

of a disturbance of that compensatory mechanism which, in health, causes an acceleration of the heart, amplified respiration, and increased vaso-constriction when there is a sudden fall of arterial tension. Now, however, this compensatory mechanism is abolished, because the shock has caused an inhibition of the bulbar centres which preside over this compensatory mechanism; consequently, to successfully treat this disturbance of the circulation we must restore these exhausted centres.

From the remedies that are employed to influence the pulse-rate we shall select for consideration the following: Digitalis, suprarenal capsule (adrenalin), strychnine, liquor trinitrini, ammonia, alcohol, ether, caffeine, atropine, musk, and therapeutic saline infusion.

Digitalis.—This drug is capable of causing the heart's beat to become slow, and of increasing the force of the systole and the extent of expansion in diastole, and, lastly, of contracting the peripheral vessels. The combined action of causing the peripheral vessels to contract and of increasing the power of the heart is to raise the blood-pressure.

Can we hope to reduce the excessive heart-rate by administering in cases of shock a drug usually considered a cardiac tonic? The answer to this will largely depend upon whether we consider that digitalis is capable of causing a contraction of the vessels supplied by the splanchnic nerves.

Rose Bradford evidently supposes that digitalis has this power. He says: 'The constricting action of digitalis on the muscular coat is best seen in those vessels of the body that are most freely innervated by the vaso-motor system, and it is perhaps for this reason that the kidney vessels, and the intestinal vessels generally, are those on which the action can be most readily demonstrated. This, however, does not necessitate that the drug should produce its effects by acting on the vaso-motor centre, and it can be definitely shown that it has a direct local action on the muscular coats of these vessels.'*

Gottlieb, in his address at the (1901) German Congress of Internal Medicine, said that vaso-motor stimulants, such as strychnine, caffeine, and camphor, which act on the splanchnic nerves, might bring about an alteration in the distribution of blood, but he maintained that digitalis was a drug that did not act on the splanchnic area; it was essentially a cardiac tonic.

* Hale White, 'Text-book of Pharmacology,' p. 120.

Many clinical observations have shown us that while digitalis cannot be relied on by itself, it is of great utility when it is used to augment the action of other drugs and saline solution. We are compelled, however, to believe that digitalis has but little power in causing a contraction of those innumerable thin-walled veins in the splanchnic area, the dilatation of which is largely the cause of the disturbance in the circulation.

In health the contraction of the arterioles that follows the administration of digitalis raises the blood-pressure. In shock these vessels are in a state of relaxation, and one of the beneficial effects of digitalis will be to cause a contraction of these vessels. This the drug is capable of doing, except, perhaps, in cases of intense shock. But the contraction of these vessels can raise the blood-pressure only slightly, because the amount of blood entering the right side of the heart is deficient in quantity; the ventricle, in fact, does not fill during diastole, since the very rapidity of the heart interferes with an adequate filling of the ventricles, whose walls must be almost in a state of spasm from the rapid contractions.

We cannot afford to despise the small augmentation in the blood-pressure gained by the action of the digitalis on the arterioles, for any gain in vascular tone enables the heart to act better, because it meets with resistance, and by reducing the dilatation of the arterioles we prevent the blood-pressure becoming rapidly lowered by preventing the blood flowing too quickly from the arterioles into the veins.

As digitalis increases the force of the heart's beat, this will be of value when we inject saline solution into the circulation. It would be, however, of little use without an addition of fluid to the circulation, because the rapidity of the beat does not come from any weakness of the heart or want of force; the rapidity is due to an inadequate supply of blood to the right side of the heart.

Thus we have found that in cases of shock where the patient's heart is strong and healthy digitalis is of some service; in cases where the patient has a weak heart we believe it is of very great service. By the term 'weak heart' we mean to imply that the patient's heart has a weak action, due to that general debilitated condition of the body which we so often see accompanying malnutrition and anæmia. In a patient with such a heart we have frequently observed that, after performing even a simple

section, such as the removal of a small ovarian cyst, we have to deal with a greatly accelerated pulse. With such hearts we have a double danger to face, the shock plus the naturally enfeebled condition, and the latter is almost as dangerous as the former, especially if the heart be dilated, for then the degree of dilatation of its cavities is in an inverse ratio to its power of doing work.

We have found that digitalis acts most satisfactorily on such a heart provided that the patient has been brought well under its influence by administering the drug for some weeks before the operation. Then it will be found that such a heart responds most readily to digitalis after the operation, and by its means we can greatly aid the heart's action, for the drug, as we have mentioned above, will cause a slight rise in blood-pressure, and this rise will act as a stimulus to the vagus roots and augment the action of the drug on the vagus centre, and this will tend to slow the action of the heart; the coronary arteries will receive an augmented blood-supply, which will improve the nutrition of the right ventricle.

While the digitalis itself does not greatly alter the condition of the circulation in cases of shock, its action is valuable, because it enables a weak heart to augment its power, not only as a pumping machine, but as a suction pump.

As digitalis is clearly a drug to be employed, the next point to decide is the preparation to be administered and the manner in which it is to be given.

As digitalin is always to be procured in the tablet form, one naturally tries this preparation. The result of our own trials, and the opinion of those who have tried it, seem to show that it exerts no effect whatever on the pulse, and at present digitalin is considered to be clinically uncertain. The explanation of this is obvious if we accept the experiments of Arnold and Wood, who have shown that digitalin $\frac{1}{4}$ grain corresponds to Tr. digitalis 16 minims; as we are directed to administer this drug in doses of $\frac{1}{100}$ grain,* we can easily see how this substance is of little avail.

* The crystallized digitalin of Nativelle consists chiefly of digitoxin, the digitalin of Homolle and Quevenne consists chiefly of digitalin, and German digitalin consists chiefly of digitalen and digitonin. . . . The German digitalin may be given in doses three times as great as Homolle's digitalin, or ten times as great as that of Nativelle (L. Bruton, *Lancet*, August 18, 1900).

Having noticed how utterly inadequate the ordinary dose* of digitalin was, we abandoned the use of this preparation, and now confine ourselves to the subcutaneous injection of $\frac{1}{2}$-drachm doses of the tincture of digitalis, taking care not to administer more than 2 drachms in the first twelve hours after the operation. But we must again repeat that if we expect to gain the full benefit from digitalis it must not be commenced at the last moment, for a single injection will not show any action for at least one hour, and its full effect is not apparent until three or four hours have elapsed; consequently digitalis is a drug that is useless in an emergency.

Suprarenal Capsule (Adrenalin).—As we have remarked, digitalis is a drug that is useless in an emergency; we accordingly have looked for a drug whose action is more rapid, so that it might be used at a moment's notice.

The drug of all others that can be relied on is a preparation of suprarenal capsule.

Having read the results of the experiments that have been tried with preparations of the suprarenal gland, we immediately thought that we had at last procured a drug capable of causing a contraction of the vessels dominated by the splanchnic nerves, for Oliver stated in his Croonian Lectures,† as a result of his experiments with Schafer,‡ that 'though we were unable to record any plethysmographic observations on the intestines, it may be fairly assumed that the great rise of the blood-pressure which invariably follows the injection of the extract is in all cases due very largely to the contraction of the arterioles of the splanchnic area. We have proved that this contraction is not indirectly produced through the vaso-motor centre, but is an immediate effect on the muscular tissue of the smaller arteries in mammals, for it occurs equally well after the destruction of the bulb or section of the cord.' Quite recently§ Schafer has said: 'Another class of cases in which the extract (of suprarenal medulla) in question may prove of the greatest clinical value are those of sudden cardiac failure, whether as the result of shock or hæmorrhage, or of an overdose of anæsthetics. . . . I

* Montgomery, in his 'Text-book of Gynæcology,' recommends the injection of $\frac{1}{10}$ grain to $\frac{1}{4}$ grain of digitalin in shock.

† *Lancet*, June 13, 1896.

‡ *Journal of Physiology*, vol. xvi., 1894, and vol. xviii., 1895.

§ *British Medical Journal*, April 27, 1901.

have seen such remarkable results from the application of this method to animals in which the circulation had apparently entirely ceased, and in which the heart has been completely resuscitated by the action of the drug, that I have no hesitation in recommending that it should be tried in this class of cases in the human subject.'

We have tried suprarenal capsule by the mouth and by the rectum, and have recently tried adrenalin hypodermically. There can be no doubt that this substance is capable of acting on the muscular coats of the peripheral arterioles and on the heart muscle itself, and that the blood-pressure is raised more quickly by this substance than by any other drug that we possess. But neither experiments nor clinical results show that the drug is capable of exerting a constricting influence on the vessels of the splanchnic area. We have tried this drug, and we have noticed the immediate and beneficial effect it has on those cases which we have referred to as cases of 'weak heart,' and we have seen benefit from suprarenal substances in cases of shock; in short, it is an invaluable remedy in a failing heart, because it acts more rapidly than strychnine, ammonia, or digitalis, but we doubt whether it is capable of sufficiently influencing the vessels of the splanchnic area. Gottlieb* appears to be of this opinion, for he says: 'Das stärkste Gefässverengerungsmittel, das suprarenin der Nebennieren hat für die Behandlung der allgemeinen Blutvertheilung noch keine therapeutische Bedeutung erlangt.'

When employing the suprarenal extract, the active principle called adrenalin, recently introduced by Messrs. Parke, Davis, and Co., will be found most useful, as it can be used hypodermically in quantities of from 5 to 10 minims.

It is unwise to administer large doses of adrenalin, because the heart becomes quickly embarrassed. On one occasion, at the conclusion of an operation the patient's heart-sounds were very feeble, and the pulse could hardly be felt; 15 minims of adrenalin were injected under the skin. We kept our ear to a stethoscope and counted for fifteen seconds. By that time the heart's action was greatly embarrassed; it seemed that it could hardly expel the blood from its ventricles. This condition of things continued, and became so alarming that we gave the patient some nitrate of

* Gottlieb, 'Herzmittel und Vasomotorenmittel,' Verhandlungen des Congresses für Innere Medicin, 1901, p. 24.

amyl to inhale. In ten seconds the embarrassed condition of the heart had disappeared, the beat became strong, and the pulse at the wrist was excellent for some hours.

We now find that 5 minims of adrenalin injected every three hours is quite sufficient, and we employ these injections with $\frac{1}{2}$ drachm of the tincture of digitalis injected under the skin, or a drachm given along with the submammary saline fluid; and the best results are obtained when in addition to these drugs we inject this normal saline solution.

Strychnine.—Clearly, if we cannot bring about an alteration in the splanchnic area by pure heart tonics, we must call to our aid vaso-motor stimulants; and the drug that we would employ from theoretical considerations has been proved clinically to be the most efficacious. That drug is strychnine. The injection of strychnine acting on the vaso-motor centre causes a constriction of the smaller arterioles; the heart itself does not appear to be directly affected, and even considerable quantities when injected do not cause any increase in the strength of the contraction. The action of strychnine in raising the blood-pressure is due mainly to the action on the arterioles of the internal organs. Even the vessels of the muscles and skin are not constricted; on the contrary, they appear actually to dilate, as though the vaso-dilator centre is stimulated, and allows of an increase in the calibre of the vessels. This latter action is of no benefit to the patient in shock, for the vessels of the skin are already dilated; for this reason strychnine by itself we have found does not give as good results as strychnine combined with digitalis, or supra-renal capsule, both being augmented by normal saline solution.

Now, although strychnine is largely employed in the treatment of shock, neither the employment of this drug for days before the operation, during the operation, or after the operation will prevent the pulse-rate increasing in the most alarming fashion if the operation has been a long and severe one; in fact, if given in too great quantities there is a distinct fall in arterial pressure.

We have watched a case where strychnine was administered for some days previous to the removal of two very adherent tubes and ovaries; the operation was long and difficult, and the strychnine was continued after the operation. The pulse-rate is shown in Fig. 109, and the patient was saved by the injection of salt solutions twenty-four hours after the operation. When

the symptoms of shock had disappeared twelve hours later (thirty-six hours after the operation), the patient had convulsions from the strychnine previously injected. She recovered.

Though it is asserted that strychnine does not act directly on the heart, the pulse of a patient after a section who has a 'weak heart' is often altered for the better in a most remarkable way after the injection of $\frac{1}{10}$ grain of the sulphate of strychnine. This is explained by its action on the vaso-motor centres; others maintain that the motor ganglia of the heart are stimulated (Brunton and Cash).*

Liquor Trinitrini.—Howard Kelly, speaking of remedies to be employed in shock, says: 'As a rapid cardiac stimulant, nitro-glycerine in the dose of $\frac{1}{150}$ grain, given hypodermically every two hours, is of service.' We have tried nitro-glycerine, but we have seen no benefit from it. One is led to the conclusion that this is a most unsuitable drug in shock, for its chief action is to lower the tension of the arterial system by allowing the vessels to dilate. That it may have a slight power to increase the heart's work may be granted, but this slight gain is certainly not compensated for by its action on the arterioles. These, as we know, are already dilated; there is no object in further paralyzing the muscular walls of the vessels. It is certainly true that nitro-glycerine has been employed with good effect in syncope and cardiac failure, and we may suppose that this drug is efficacious when the syncope is due to spasmodic contraction of the arterial vessels supplying blood to the brain; while in other cases, 'if sufficient blood is not driven into the brain, owing to deficient power in the heart itself, nitrites may be useful by their direct influence on that organ, and indirectly by dilating the vessels, and thus relieving the heart of some portion of its work.'†

If we employ nitro-glycerine during shock, we should take the precaution of having the patient's head low, lest more harm be done than good. We have tried hypodermic injection of a tabloid composed of digitalin, strychnine, and nitro-glycerine, but have seen no good results in cases of shock.

Another objection that we would urge against nitro-glycerine is that, as Oliver‡ has pointed out, the vaso-dilatory action of

* 'St. Bartholomew's Hospital Reports,' vol. xvi.

† Leech, Croonian Lectures, July 15, 1893.

‡ *Lancet*, June 6, 1896.

nitro-glycerine probably extends to the splanchnic area, and he has shown that the blood-pressure of a patient under the influence of nitro-glycerine can be raised very markedly by abdominal pressure.

Ammonia.—We have come to regard ammonia as a very valuable stimulant, acting as it does on the heart itself, increasing the pulse force, and raising the arterial pressure. It also acts powerfully on the respiratory centre, and possibly on the vaso-motor centre. It is undoubtedly of the very greatest service when used soon after an operation, as it tends to overcome the circulatory and the respiratory depression. As it cannot be administered by the mouth, it may be given by the bowel. Great care must be exercised if the liquor ammoniæ fortis be given hypodermically, as we have seen large sloughs result.

Alcohol.—Although it is a universal practice to administer alcohol in cases of shock, we do not consider that the pulse is improved by continuing to administer brandy. A small quantity is probably of some use, and the pulse improves for a time, but the ultimate result of the administration of much brandy is that the ventricular contraction grows weaker under its influence. In cases where ether has been administered as the anæsthetic, alcohol should not be given, as it will only add to the depression already caused by the ether, because alcohol is so nearly allied physiologically and chemically to ether.

Ether.—Hypodermic injections of ether act rapidly, but their action is fleeting. Ether is certainly capable of increasing the pulse-rate and the force of the heart's beat, and, by increasing the activity of the vaso-motor centre, it raises the blood-pressure. It may be tried if there is much depression, but we cannot hope to get any permanent or wide-reaching result from its employment. We need hardly remark that it is not to be employed if ether has been used as the anæsthetic.

Caffeine.—This drug slows the pulse-rate and strengthens the heart. Gottlieb considers that it acts better on a diseased heart than on a normal one.

It can be used in an emergency, for it acts rapidly; but it must not be given in large quantities or often, as it causes cardiac acceleration.

Caffeine may be given in the form of coffee by the bowel. Robb, in his series of 114 consecutive sections without a death, gave as a matter of routine '2 ounces of black coffee, in two

doses an hour apart, on her arrival in the ward after the operation.'

Caffeine cannot be used by itself hypodermically owing to its decomposition in the presence of water. The following solution may, however, be used: Salicylate of sodium, 30 parts; caffeine, 40 parts; and distilled water, 60 parts (Hare); 5 minims of this may be injected.

Atropine.—In small doses atropine is capable of increasing blood-pressure very considerably, because it stimulates the vaso-motor centre in the medulla. Wood and Hare both think that atropine is of great service in shock. Hare says: 'The use of atropine is peculiarly a triumph of experimental therapeutics, and rests upon logical deduction. . . . A safe dose does not act so much upon the vagus as upon the vaso-motor system, and by preventing the dilatation of the blood-vessels of the body thereby provides blood-paths of normal tone and tenseness, which do not hold all the blood in stagnant pools where it is not needed, but carry it to the brain and vital parts.'

In a series of cases where previous to the operation we injected morphine ($\frac{1}{8}$ grain) and atropine ($\frac{1}{100}$ grain), we found that there was less disturbance in the circulation after the operation than in a series of cases in which we did not use these drugs.

Crile says: 'Atropine, hypodermically administered, was an efficient protection against cardiac inhibition in operations in the "inhibition area," on the larynx, and in such operations as might cause mechanical stimulation of the vagi. Some observations on preliminary injection of atropine to prevent splanchnic shock leave us in doubt as to its efficiency, but on the whole the evidence would seem to show that shock was diminished.'

Schafer has pointed out that if atropine is employed, followed by suprarenal capsule, there is a very great rise in blood-pressure. We must be careful in employing atropine and suprarenal capsule after the patient is placed in bed, if there is much collapse, lest the heart's action should be embarrassed.

The objection that we have to the employment of atropine after abdominal operations is the tendency it has to cause the skin to become dry, and also because it probably has some influence in paralyzing the intestinal ganglia, although the muscle-fibres of the gut retain their irritability. This is the result which we most particularly do not wish to occur, as we have pointed out in dealing with tympanites

Musk.—We would not have mentioned this drug were it not that it is often employed on the Continent for cases of shock. It appears to be almost worthless, and Hermans* denies that musk has any stimulating effect on the circulation or respiration.

The tincture of musk in doses of 20 minims to a drachm is the form in which it is employed on the Continent. It must be freshly prepared, as otherwise it is apt to contain septic organisms (Cheyne and Burghard).

Injection of Therapeutic Saline Solution.—When we consider the condition of the circulation in shock, it would appear at first sight that, since the arteries and capillaries are far from full, the most natural thing to do is to inject saline solution in sufficient quantity to compensate the heart and arteries for the deficient blood-supply, due to the venous engorgement in the splanchnic area.

But while the idea is very feasible, practice shows that, in the case of severe shock, although we may get a slower pulse and one having considerable tension, this is too often a transient amelioration of the condition, and that the vessels soon become collapsed again, while the heart-rate rises.

The first injection of a litre or more of saline is almost invariably followed by some improvement in the pulse in every case of shock after a section, especially when the injection is made soon after the operation. If we repeat this injection in from nine to twelve hours, or if we introduce a pint of saline by the bowel, we again get an improvement of the pulse, and the patient may progress satisfactorily from this time onwards. If, however, the patient continues in that condition which we have described as 'continued shock,' when we frequently have a pulse-rate of 140 to 160 eighteen to twenty-four hours after the operation, we find then that neither the injection of saline solution by the bowel nor subcutaneously has an appreciable effect on the pulse-rate; in fact, we have in several instances thought that the patient's condition was made worse, and the patients that appear to be least relieved are those who are very anæmic before the operation, the anæmia not being the result of hæmorrhage but malnutrition. In these cases the vital centres are acting imperfectly, and after the transfusion dyspnœa may become a conspicuous symptom, for the blood is so diluted that there is imperfect aeration in the lungs, and this hydræmic condition of

* Hermans, 'Untersuch. u.d. Einfluss d. Moschus a. Tiere,' Bonn, 1888.

the circulatory fluid can hardly be expected to act favourably on the vaso-motor centres. Furthermore, the experiments of Roy and Adami show that in an artificial hydræmia, although the work done by the heart may be doubled or trebled, the force of the contractions of the auricles and ventricles, instead of being increased in order to cope with the increased work thrown upon the organ, are diminished. This weakening of the heart may be satisfactorily explained by the thinning—the lowering of the nutritive value—of the blood which passes through the coronary vessels.

Crile has shown by his experiments that after a high degree of shock had been produced, accompanied by arterial and capillary depletion and venous engorgement, an infusion of warm saline solution could raise the blood-pressure everywhere; in fact, all the peripheral, venous, arterial, portal, and cephalic pressures rose within a few seconds of the beginning of the saline flow.

This is what we would expect, but, unfortunately, this favourable change does not always persist, the reason being, as the experiments of Cohnheim, Lichtheim, Sherrington, and Copeman have shown, that if a saline solution is injected into the vascular system of the dog, a considerable portion of it escapes in a comparatively short time from the circulation, and that the portion which escapes is recoverable, not from the muscles or skin or lungs, but from the peritoneal chamber of the intestines.*

Hæmorrhage.

When, however, we come to deal with the rapid pulse due to **hæmorrhage**, we find the heart beats with an increased rate, for it is working with half-filled vessels, and the rate increases if the bleeding vessel is not secured.

If, however, we secure the bleeding-point, the vessels gradually refill, as all the organs and tissues of the body quickly supply serum to the blood; and if now we administer saline by the

* C. S. Sherrington and S. M. Copeman says: 'Our experiments indicate that in the rabbit, when a quantity of normal saline varying from 2·5 per cent. to 25 per cent. of the body-weight is injected into the circulation rapidly—*e.g.*, in less than sixty seconds—two-thirds of the injected quantity has usually passed out of the circulation again by the end of the first five minutes succeeding the injection' (*Journal of Physiology*, London and Cambridge, xiv., 1893).

bowel, or inject it into a vein or under the skin, the blood-pressure rises and the pulse improves wonderfully.

If, however, during the course of the operation the patient not only loses blood, but she sustains shock as well, we see how absolutely important it is to employ saline fluid ; for although the result may disappoint, no drug treatment and no supply of stimulants can be as effectual as the injection of saline in such cases.

Résumé.

A consideration of the preceding sections leads to the following conclusions with regard to the treatment of circulatory complications after sections :

1. Strychnine can be employed before, during, or after the operation with great benefit.

It is not necessary to employ more than 25 minims of the liquor strychninæ hydrochloridi in the first twelve hours. This will include what is given during the course of the operation.

2. Digitalis is invaluable, as it tends to restore normal vascular tone, while it acts as a cardiac tonic when the heart itself is weak. The tincture may be administered hypodermically,* or it may be given by the bowel ; $\frac{1}{2}$ drachm doses would be employed, and not more than 2 drachms need be used in the first eighteen hours.

Digitalin should not be employed, as the quantity at present ordered to be given ($\frac{1}{100}$ grain) is evidently useless.

3. In order to get the best results from digitalis, its administration should be commenced in women whose hearts are weak some days previous to the operation.

4. Carbonate of ammonia is a stimulant to be regarded as much superior to brandy, and it may be administered by the bowel soon after the conclusion of the operation ; 20 grains may be given in the first enema, and 10 grains may be given four hours later.

5. If a rapid effect is desired, 5 minims of adrenalin may be injected subcutaneously, in order that the blood-pressure may be raised at once.

6. A pint or more of therapeutic saline solution is invaluable

* It frequently causes inflammation in the tissues when administered hypodermically. We frequently pour $\frac{1}{2}$ drachm into the saline fluid that is being injected under the breasts.

in the rapid pulse due to hæmorrhage and shock. The first injection may be augmented by a second one, administered as an enema, eight hours after the operation, and a second subcutaneous injection may prove of service eighteen or twenty-four hours later if the arteries are collapsed. The best results are obtained when saline injections are administered and hypodermic injections of strychnine and adrenalin are given at the same time.

Practically, then, when we come to deal with a rapid pulse of low tension immediately after a section, and, in the majority of cases, due to shock or hæmorrhage or both, we should give a subcutaneous injection of saline, administer strychnine and adrenalin hypodermically, and inject into the bowel the following enema :

Carbonate of ammonia	gr. xx.
Carnrick's liquid peptonoids	℥j.
Brandy	℥j.
Tincture of digitalis	ʒss.

With sufficient water to make it 8 ounces.

This injection may be repeated in three hours, but then only 10 grains of carbonate of ammonia need be administered. After this the enema may be repeated every four hours, the ammonia being omitted altogether.

When the patient shows signs of reaction this enema acts well, as the brandy flushes the cutaneous vessels, and so helps to bring about a redistribution of blood, the patient's head in the meantime being kept low.

During the whole time that the circulation is disturbed it is most essential that the patient's head should be kept low and that the foot of the bed should be raised, so that the blood may be brought to the bulbar centres ; for when the compensatory mechanism, which is one of the functions of these centres, is not acting, the continuation of the circulation is only possible in the recumbent position, and it is greatly aided by having the head lower than the extremities. We have no doubt that the inhalation of oxygen is a valuable aid to the patient while in this position.

CHAPTER XXVII

TREATMENT OF PYREXIA AND HYPERPYREXIA

Pyrexia—by which term we would denote any temperatures between 100° and 103·5° F.—occurring after a section seldom calls for special treatment, although the cause of the temperature may.

On the other hand, hyperpyrexia will usually demand special measures.

Thornton, Bancroft, and many other surgeons fifteen or twenty years ago held strong views on the necessity of treating pyrexia, and they were accustomed to largely employ Leiter's regulator or ice-bags. The introduction of such antipyretic drugs as antipyrin and antifebrin opened up a new and ready means of reducing temperature, and so Leiter's tubes fell into disuse. But at the present day neither Leiter's apparatus nor antipyretic drugs are largely employed after sections, because we have arrived at a stage when the prevalent idea is that the pyrexia may be in many instances a protective or a defensive mechanism, while there is little evidence to show that the use of mere antipyretic remedies, such as antipyrin and phenacetin, reduces mortality.

Again, it is widely recognised that moderate pyrexia does no harm, and that the lowering of the temperature is but the 'changing of the hands of the clock while the inner works remain unaffected'; we are treating a symptom but not the cause, and as the temperature may be regarded as some indication of the degree of effect that the pathological cause is producing on the organism, we, by employing an antipyretic line of treatment, deprive ourselves of a guide and indicator, filling ourselves with a false sense of security in thinking that because the temperature has fallen the disease has abated.

These arguments do not apply to hyperpyrexia, because it is

very generally admitted that a temperature over 104° F. when continued produces tissue waste, for the organism consumes its own proteid and fat, and the most vital parts may be disorganized; consequently we are justified in resorting to antipyretic measures in such cases.

For the first week we may, as a rule, regard the fluctuations of the temperature chart as a guide to indicate whether the patient's condition is one of comfort or discomfort.

If the patient complains that she is too hot, and we find her temperature is 101° F. or even less, it will be necessary for the nurse to remove some of the bedclothes. A blanket may be removed or the clothes may be raised on a bed-cradle, or hot-water bottles may be discontinued, or the fire may be allowed to die out; we are able, then, to encourage a natural means of lowering the temperature—*i.e.*, by favouring an increased loss of heat.

If the patient continues restless, and still complains that she is too warm, and we find that the skin is dry, we should resort to sponging, and we must endeavour to get the skin to work in order that we may not overtax the kidneys; this is, indeed, a matter of very great importance in elderly women.

If we have any difficulty in inducing the skin to become moist, we may give a little Dover's powder combined with antipyrin, followed by some whisky or brandy, and when the patient breaks into a gentle perspiration, she feels at once relieved, and often falls into a gentle sleep from which she awakes refreshed.

The Keiths have pointed out that in a dry condition of the skin with pyrexia, such as we have just mentioned, excellent results may be obtained by using very small injections of morphine, and they rightly lay particular stress on the bad effects that atropine exerts on the skin when given in large doses during or after the operation.

It is well to remember that a patient may be very uncomfortable and complain of heat even when the temperature chart shows no great rise. This is a condition that has been described as 'fever without elevation of temperature,' and it is explained by Harnack as being due to an increased gain of calories by a body which undergoes isochronously a loss of a similar amount.

When the pyrexia is due to sepsis, it is difficult to see how we can gain anything by attempting to reduce the temperature. The skin is here not dry—on the contrary, it is generally covered with

perspiration—there is not a deficient loss of heat, and there is an increased production due to substances which depend for their existence on bacteria. The rise of temperature may here be as much a defensive mechanism as chemiotaxis or phagocytosis.

In dealing with hyperpyrexia our first step will be to endeavour to ascertain the cause, and in this connection we must not forget lung affections and malaria as possible complications.

Kelly is inclined to think that some alarmingly high temperatures are due to a marked hysterical temperament,* but such a diagnosis should, as he says, only be accepted as a last resort after the most careful exclusion of every other possible source; it is just in such cases that the greatest injustice is sometimes done the patient.

In treating hyperpyrexia we may resort to the application of cold, aided by the administration of antipyretics.

The following extract from Keith† will illustrate the treatment:

'What is usually done is to apply cold to some part of the body by passing a stream of iced water through a coil fitting the head or lying on the abdomen. A less cumbersome method is to fill thin sausage-shaped ice-bags with small pieces of ice, and place one on the head and one on each side of the neck, so as to reach the large bloodvessels.

'When the ice fails to bring down the temperature, as in the following case, it will be necessary to apply cold to the limbs and abdomen. In March, 1886, a non-adherent ovarian tumour was removed from a patient aged forty-five. Progress was fairly satisfactory until forty-two hours after the operation, when the temperature was 102·6° F. and the pulse 130. Ice-bags were put on the head and neck at this time.

'Forty-six hours: Has had 15 grains of quinine by the mouth in the past hour. Temperature, 103·8° F.; pulse, 134.

'Forty-seven hours: Six minims of tincture of aconite. Temperature, 104° F.

'Forty-eight hours: Temperature, 105° F.

'Forty-nine hours: Feels as if she were being burnt up. In

* We have known the temperature in three instances, on different occasions, in nervous women to shoot up to 104° and 105° F. some days after their confinement upon hearing a lion roar in a circus situated close to a maternity hospital. The temperature in each case fell within twelve hours to normal. 'Emotional fever' occurring after confinements has been frequently described; we have no doubt that it occurs rarely after sections.

† *Loc. cit.*, p. 75.

addition to the ice-bags, cloths wrung out of ice-water were applied to the legs, arms, and abdomen, and were changed every three or four minutes. Temperature, 106·1° F.; pulse, 142.

'In half an hour the temperature had fallen to 103·8° F., in another half-hour to 101·5° F., and a quarter of an hour later the temperature was 100·3° F. and the pulse 118. The application of the cold cloths was discontinued, the ice-bags alone being left on; the temperature did not again attempt to rise, and the patient made a rapid recovery.'

Levison, of Copenhagen, reports the occurrence of a high temperature after an ovariotomy performed by Koefoed. The patient was sixty-three years of age. Thirty-six hours after the operation the temperature rose rapidly; it reached 109·4° F. The woman became unconscious, and had a pulse of 136 and a shallow, irregular respiration. The dressing was removed, and the incision covered with a layer of collodion in which iodoform had been dissolved.

Ice was then applied to the abdomen and to the head. In one hour the temperature was reduced to 104° F., and after twenty-four hours to 100·6° F., when the woman became conscious. The improvement continued for eight days, when the patient died from an attack of acute pneumonia of the right side. No trace of peritonitis was found at the autopsy.

CHAPTER XXVIII

THE BOWELS

One has only to look through the classical works of Wells, Doran, Hegar and Kaltenbach, and others, written fifteen or twenty years ago, to appreciate the great change that has taken place in the after-treatment of section cases with regard to the evacuation of the bowels.

Wells, in 1872, wrote: 'The bowels are kept quiet after the operation, and as long as the patient feels comfortable their action need not be brought on, even if they do not act for ten days or more. I have known them nineteen days without acting, and then act naturally without any painful effort.'

Even Tait, in 1877, wrote: 'The intention of the use of the catheter is to keep the pelvis as quiet as possible, and for this purpose it is also well to administer occasional small doses of opium to prevent any action of the bowels for seven or eight days. . . . In some cases the bowels may remain without action for the twelve or fourteen days after the operation without giving rise to any uneasiness.'

Doran, ten years later, wrote: 'I find that it is a very good rule to take steps to open the bowels by the evening of the seventh day. . . . To begin on the second or third day with purgatives when no bad symptoms are present seems to me a great mistake. I know of a case where hysterectomy was performed, and sulphate of magnesia was administered twenty-four hours later. The patient was immediately seized with vomiting, and died in a few hours.'

To leave the bowels alone was obviously the practice of the past, and this is in marked contrast to the practice of some of the present-day gynæcologists, if we take the following as an example:

'As soon as the patient awakes from the anæsthetic 1 drachm of sulphate of magnesia in 1 ounce of water, or an equivalent

dose of some mineral water, or $1\frac{1}{2}$ ounces of liquid citrate of magnesia, is given every hour, and repeated immediately whenever vomited. About six hours after the operation is completed a stimulating enema is given, consisting usually of 2 ounces of glycerine and 4 of water, or from $\frac{1}{2}$ to 1 drachm of inspissated ox-gall in $\frac{1}{2}$ pint of water (without glycerine) is thrown into the upper rectum, and repeated every two or three hours until flatus passes freely between enemas. When this occurs, the saline is also stopped, but not until then. In trying to start the passage of gas most surgeons think it enough if gas and fæces come with the enema, but this is not sufficient. The treatment must be continued until flatus passes freely between enemas; and if it ceases to pass occasionally after the enemas have been discontinued, then another should be given.'*

This plan, advocated by Byford, represents the practice of a large number of surgeons of the present day, while there are others who are not so eager to obtain an evacuation of the bowels. Thus Olshausen,† in speaking of his after-treatment of hysterectomy cases, says that an enema is given on the fourth day, and if necessary a purgative on the fifth.

A. Martin‡ generally gives a laxative on the fifth day after ovariotomy. Kelly says: 'If the patient is doing well in other ways, it need cause no worry should the bowels be sluggish and not respond until late on the fifth or sixth day. . . . As a routine line of treatment I give on the evening of the second day something which will move the bowels on the following morning.'

Tait's practice in the latter years of his life was to purge freely, and to administer enemata quite early. He said on one occasion: 'It is the business of any nurse watching one of my abdominal sections to note every six hours a set of four conditions—the pulse, the temperature, the occurrence of distension, and the passage of flatus *per anum*. So soon as the latter is freely and naturally established our anxiety ends, though our watchfulness is unremitting. The want of such passage for twenty-four hours after an operation, especially if accompanied by the slightest suspicion of distension, is dealt with without fail by the nurse herself, on her own responsibility, by the adminis-

* Byford, 'An Improvement in the Technique of the After-Treatment of Peritoneal Sections' (*Am. Journ. Obstet.*, July, 1898).

† 'Handbuch der Gynäkologie,' Veit.

‡ 'Krankheiten der Eierstöcke.'

tration of a turpentine enema, unless she has been specially warned not to give it for some special reason, such as a rent in the rectum. If the turpentine does not answer, the nurse reports, and a mild saline purgative is ordered—generally a Seidlitz powder—and this is repeated every four hours until it acts. If there should be any special anxiety, such as the occurrence of vomiting or the presence of a clamp, 5 grains of calomel are given instead of the Seidlitz powder. If the distension increases, we never rest till we have had the bowels moved, and then our anxiety is nearly always at an end, and our efforts rewarded by recovery. But, above all things, there must be no time lost.'

Without quoting any other opinions, we may assume that it is now a universal practice to encourage the expulsion of flatus, and to obtain an evacuation of the bowels, during the first four or five days after the operation. We must next inquire by what purgatives and enemata this is best accomplished.

Purgatives.—Before describing the method of administration of cathartics, we may devote a little time to the consideration of the drugs usually employed.

For some years we have been seeking for a drug that will be suitable for administration after a section. What we want is a drug whose dose is small, whose action is rapid, and which, by its taste, does not cause the patient to vomit.

We have, in our endeavours to obtain such a drug, tried nearly every purgative in the Pharmacopœia. Our plan was to select a drug, and then to select a certain number of patients in the wards of the hospital, and administer to them for a few days a well-known purgative, such as liquid extract of cascara, so as to gauge the strength of their bowels. After this, each of the patients received for a week doses of the selected drug.

The result of these trials is that after sections we have found that the following drugs are the only ones that need be employed: Calomel, elaterium, sulphate of magnesia, liquid extract of cascara, croton oil, and occasionally castor oil.

Calomel has proved itself to be the most reliable drug of any tried, provided that it is combined with elaterium.

Calomel by itself, however, utterly failed to act in many instances.*

This failure of the drug to purge is in some cases probably due to the fact that the present-day calomel is manufactured with great

* A. Martin has abandoned calomel, and now prefers castor oil.

care; when, however, we obtain some common cheap varieties not altogether free from sublimate, the drug acts much more effectually.

Again, according to Schmiederberg, the purgative action of calomel is due to a purely local action, consisting in a stimulation of the intestinal ganglia; these ganglia after many sections, especially in cases of shock and peritonitis, are apparently capable of a lesser degree of excitation than in health.

The temperature of the patient at the time the drug is administered is of some importance, and we have convinced ourselves that when the temperature has risen to 100° F., calomel acts less effectually than when the temperature is normal. This rule applies to all cases, whether an operation has been performed or not, and it is especially true when applied to children.

The dose and the method of administration are of considerable importance.

Calomel has this peculiarity, that its cathartic action is not increased in proportion to the dose (Wood); in fact, a very large dose of calomel appears almost to be a sedative, and consequently 1 or 2 scruples given every half-hour is not an uncommon dose in severe cases of yellow fever, while 120 grains has been given in cholera in a single dose.

Remembering this peculiarity of calomel, we can quite understand the case that Goodell* reports when he gave 70 grains of calomel (10 grains every two hours) before the bowels acted.

We now know from experience that these large doses are quite unnecessary, and that calomel given after a section in minute doses—say of $\frac{1}{2}$ grain—every half-hour until 3 or 4 grains have been taken will act as effectually as 10 grains taken in a single dose.

The reason that numerous small doses are as efficient as large ones lies in the fact that only the calomel which is changed into the gray oxide is active, and as the amount of alkaline juice in the intestine is small, only a minor part of a large dose of calomel acts; the major part escapes unchanged (Hare).

From the fact that we are able to give calomel in these minute doses, from the fact that it is tasteless, and, thirdly, from the fact that once swallowed it is not readily thrown from the stomach—all these advantages make calomel of great value to us when the

* 'American System of Gynæcology' (Mann.), vol. ii., p. 822.

patient is vomiting and we want to obtain an action of the bowels. In fact, not only will calomel act on the bowels, but these minute doses often help to arrest the vomiting.

At times, however, calomel quite fails to act when given by itself, and therefore we now frequently administer it in combination with elaterium, and we further help its action by administering Vichy water, which also contains bicarbonate of soda.

We have found after many trials that 3 grains of calomel and 2 grains of pulv. elaterii co. in a capsule is a most efficient and gentle cathartic; the patient is not griped and not exhausted.

With regard to sulphate of magnesia, there can be no doubt that, if the patient can only retain it, it acts most effectually, and the patient is more relieved and the distension is more quickly reduced than after any other purgative. Unfortunately, a large number of patients, especially in the better ranks of life, cannot take 'salts' without vomiting. If, however, we observe the rule to give only 1 drachm of magnesia every hour in dilute solution, the patient is not so liable to vomit after the first dose, which not unfrequently is rejected as soon as swallowed.

Cascara is one of the most excellent purgatives that we know of, but owing to its bitter taste it is unsuitable for administration except the patient is doing well. Lately, however, a new preparation of cascara has been produced, called 'cascara evacuant'; this preparation has a slight taste of aromatics, and when diluted with water has quite a pleasant taste, consequently this drug promises to be a very useful one. A teaspoonful may be given every hour until three doses have been administered, and these doses, aided by the enema, are followed by an evacuation of the bowels in about eight hours. Byford gives 2 drachms of cascara two hours before the case is operated on. We have tried this plan, but it did not appear to have any marked effect on the bowels unless aided by calomel and enemata later on.

We have lately thought that in cases where we expect trouble after the operation it would be a good plan at the conclusion of the operation to inject some purgative into the lumen of one of the coils of the small intestine. We did this on one occasion, injecting 1 drachm of liquid extract of cascara with a similar quantity of water. The bowels acted readily fourteen hours later when a simple enema had been administered. We think that

the plan is worthy of more extended trial; it has proved of service after operations for intestinal obstruction.

With regard to croton oil, we can unhesitatingly say that this is a drug that can be used with perfect safety and with great advantage at times.

Usually it is only resorted to when the patient is in extremis, when probably neither croton oil nor any other drug can possibly alter the complexion of the case, and consequently its true worth is not appreciated.

In a series of trials made on patients in the ward, we found that $\frac{3}{4}$ drop was quite sufficient to act on the bowels of very constipated women most effectually and without causing much pain or inconvenience. It is best administered in a capsule with a little sugar of milk. The only objection we have found to it is that, even with patients who are in good health, the oil causes a feeling of nausea for an hour or so after it is taken.

In cases where we have had great difficulty with the bowels after a section, we have given 2 drops of the oil in a capsule with good effect.*

Lastly, we think that it is a wise precaution for the surgeon to give every patient before the operation a standard dose, such as the calomel and elaterium powder mentioned above, in order to gauge the sensitiveness of the bowels to purgatives; by this means we have some idea of the amount of the purgative that will be required after the section.

As some guide to the strength of the various drugs we have tried, we find that 2 drachms of cascara = calomel 3 grains, combined with pulv. elaterii co. 2 grains = croton oil $\frac{3}{4}$ drop = sulphate of magnesia 1 ounce.

Quinine is a drug that will prove of considerable value when used at the proper moment. Often, when we cannot get the bowels to move, an injection of quinine in whisky will cause the flatus to pass with great freedom. It is, therefore, well to have a stock bottle of sulphate of quinine in solution at hand of a strength of 10 grains to the ounce of water, 10 minims of diluted sulphuric acid being added to aid the solution. If, however, we

* We were once called to a consultation when the patient, a blacksmith, was suffering from symptoms of intestinal obstruction. He had taken, by advice of his medical man, 37 drops of croton oil in divided doses, and the bowels had not acted. He suffered no inconvenience from this large quantity of oil, and he recovered without an operation.

are using the quinine in an emergency, it may be dissolved in whisky, brandy, or glycerine and water.

Alum may be very useful in helping the patient to expel the flatus. The quantity used is an ounce of powdered alum to a quart of warm water.

Asafetida in the form of an enema has proved of great service in helping the expulsion of flatus; 6 drachms of the tincture to 9 ounces of warm water is the form in which we administer it at Lewisham.

Enemata.—Tait has said: 'I have tried a vast number of different kinds of enemata, some suggested by my own thought and others suggested by ingenious friends, but I have always gone back to soap and turpentine.'

Most surgeons have had a similar experience to Tait, and after trying various enemata they invariably revert to soap and turpentine.

There is only one drawback to the employment of this enema, and that is the difficulty that is experienced in distributing the oil through the soap and water. Usually the oil, after being added to the soap and water, separates and floats on the surface, so that the patient receives the whole quantity of oil with the last few ounces of fluid that run from the can; this causes considerable pain, especially if there are any hæmorrhoids present.

Various means have been adopted in the endeavour to distribute the oil evenly throughout the fluid.

One of the most effectual ways of overcoming the difficulty is for the nurse to keep stirring the fluid in the can during the whole time that it is running into the bowel.

Another method that we have tried with success is to combine the turpentine with acacia. Sixty grains of acacia are added to each ounce of oil contained in a dry bottle, and it is then diffused by a slight shake; after this ½ ounce of water is added, and the whole is briskly shaken. This emulsion can be added to hot soap and water, and the oil does not now so readily separate.

Hare gives the following:

℞	Olei terebinthinæ	fl. ℥j.
	Olei olivi	fl. ℥ss.
	Camphoræ	gr. xx.
	Mucil. acaciæ	fl. ℥ss.
	Aquæ	fl. ℥x.

Misce.

When the turpentine fails to act, we often resort to the following, recommended by Noble:

℞	Magnes. sulph.	... ...	℥ij.
	Olei terebinth.	... ...	fl. ℥ss.
	Glycerini	... ...	fl. ℥j.
	Aquæ ...	... ...	q.s. ad ℥iv.
		Misce.	

Routine Management of the Bowels.

Having decided on the drugs that we intend to employ, we may next consider the period at which we should begin to employ means for the evacuation of the bowels.

In practice we shall find it most convenient to adopt a routine line of treatment with regard to the management of the bowels, although this is not the most logical course to pursue, as each case should be individually studied.

In our own practice we generally endeavour to get an evacuation of the bowels on the third morning (forty hours) after the operation, for long experience has convinced us that while some patients may be left for the first week without an evacuation, the majority of women have a much easier time if the bowels act during the first forty-eight hours after the operation: the temperature falls, the pulse-rate gets less, the circulation improves, vomiting ceases, distension no longer troubles them, then their pains become less, and they look and feel relieved in every way. Even when a case looks truly desperate, all may end well if only the bowel can be made to act.

Whether this early action of the bowels has any effect in checking the occurrence of peritonitis we are unable to prove with certainty, but there appears to be little doubt that whereas in the past sepsis was the cause of many cases of obstruction and paralysis of the bowels, in the present day we believe that obstruction and paralysis of the bowel are often the cause of sepsis.

By producing early peristalsis we prevent a large quantity of flatus from accumulating, we endeavour to minimize the occurrence of intestinal adhesions to raw surfaces, we prevent paralysis of the bowel from overdistension, and so prevent the escape of septic germs through the bowel walls.

In short, whatever theory we may bring forward to explain

the good results of early purgation, we may content ourselves with believing with Tait when he says : 'Of this I am certain, granting a large number of cases going on to peritonitis after operations or from any other cause, if you subject the patients (not the peritonitis) to the purgative treatment, the number who will go on to incurable peritonitis will be absolutely fractional compared to what will be the result if they are left alone or submitted to any other treatment which has come under my notice.'

This very early evacuation of the bowels may not be so necessary in a patient who has been well prepared before the operation, but if we have been called upon to act in an emergency when the operation was imperative, and the bowels had not undergone any special preparation, then in such a case it will be very advisable to endeavour to obtain a movement of the bowel within the first eighteen to twenty-four hours from the time the operation was finished.

Our routine practice is to administer on the evening of the second day (twenty-eight hours) a capsule containing calomel (3 grains) with pulv. elaterii co. (2 grains) and 5 grains of bicarbonate of soda. If the patient vomits this, another cachet is given in four hours' time containing 5 grains of calomel, as it is not wise to repeat the elaterium, lest some of this drug may have been retained from the first cachet.

During the night (thirty to forty hours), if the flatus be troublesome, the rectal tube is frequently passed, and an injection of sulphate of quinine (10 grains) in $\frac{1}{2}$ ounce of whisky, and a few ounces of water, is thrown into the bowel.

On the morning of the third day (forty hours) an enema, consisting of hot soap and water (thirty ounces) with a tablespoonful of oil of turpentine, is administered to the patient, and this, in a large number of cases, has the desired effect of evacuating the bowels.

If, however, the bowels do not act, nothing more should be done for a few hours, and then the sulphate of magnesia enema (Noble's) may be tried, or the following should the flatus be troublesome :

℞ Magnes. sulph. ... ... ℥ij.
Quininæ sulph. ... ... gr. x.
Glycerini ... ... fl. ʒij.
Aq. calidæ ... ... q.s. ad ℥x.
Mix, and inject into the bowel.

Should we still be unsuccessful, then $\frac{1}{2}$ ounce of sulphate of magnesia should be given by the mouth, and this may be repeated in four hours' time if necessary.

Very often, however, in these cases where the bowel will not act, the patient is troubled with obstinate vomiting, and it is useless to attempt to administer a large dose of magnesia, as the stomach will immediately reject it. It will be necessary to try one of the following plans:

(*a*) Administer calomel (1 grain) every half-hour until 6 grains have been given. The patient often ceases to vomit after these small doses of calomel are administered, and is able after four hours to take a Seidlitz powder, which aids the action of the calomel.

(*b*) Administer three tabloids (each 1 grain) of calomel, and in half an hour administer two tabloids of elaterin (each $\frac{1}{40}$ grain).

(*c*) Place 1 drop of croton oil on a little sugar of milk, and enclose this in a cachet and administer this. If, however, the bowels are very obstinate, and there is a rising temperature and a bounding pulse, 2 drops of croton oil may be administered with safety.

(*d*) Half a drachm of sulphate of magnesia dissolved in 1 ounce of water may be given every hour, and this may be continued every hour until six doses have been given. At this point an enema of soap and water with turpentine may be administered.

There can be little doubt that the secret of giving magnesia successfully is to give it in small doses (30 to 60 grains) in a large amount of water. If the patient is thirsty she will drink it and retain it. The first dose usually comes up, but after this the other doses are not rejected.

(*e*) In place of sulphate of magnesia we may try 2 ounces of the effervescent citrate of magnesia every 2 hours until 8 ounces have been taken.

This plan succeeds best when the vomiting is slight and the thirst great.

Should all these plans fail, and the patient be becoming rapidly distended and the pulse-rate increasing, we must resort to the various plans mentioned under the heading of Tympanites and Pseudo-ileus—*i.e.*, massage of the abdomen and the 'electric lavement'—and, lastly, an operation to make a temporary anus and drain the bowel when the patient's life is threatened.

If instead of following a routine line of treatment we determine to treat each case according to her symptoms, we shall soon see that the cases in which the intestines have been much handled will be the cases in which we shall require to begin early with our purgatives and enemata; while the cases of simple operations, such as hysteropexy and the removal of unadherent ovarian cysts, will not need our attention until the third day, and not even then if the distension is a soft one, and the pulse-rate is below 100.

If we determine to adopt early purgation, we may either follow Byford's plan, as given in the quotation in the early part of this chapter, or we may leave the patient alone for the first eight hours after the operation, and then administer a dose of calomel; this is followed in six hours by a Seidlitz powder, and an hour later a soap and turpentine enema is thrown into the bowel. In this way we can usually obtain an evacuation of the bowels within eighteen hours of the time of operation. If, however, we fail, we can continue to administer salts every hour during the second day, giving at the same time an enema every three or four hours. We shall find, however, that this treatment is always followed by great thirst, and the enemata become very distasteful to the patients.

Whatever may be our routine treatment with regard to the bowels, it must not be forgotten that, if the rectum or large intestine has been injured, enemata should not be given for the first week, the bowel should be kept at rest with opium, and we may give a gentle purgative such as castor oil about the fifth day.

We have seen ½ pint of fluid injected into the rectum three days after an operation burst through a spot in the cæcum—of a child—which had been stitched during an operation for acute appendicitis.

We have also known an injection burst through a transverse colon that was becoming gangrenous after an operation for malignant disease about the pancreas, while under the heading of Fæcal Fistula we have referred to a case reported by Butler-Smyth, when an injection burst a rectum and the fluid found its way up the glass drainage-tube.

CHAPTER XXIX

THE TONGUE

For a considerable length of time we have been accustomed, during the first four days following a section, to make several sketches of the patient's tongue in the case-book, and these sketches have been afterwards copied into a separate book, in order that we might ascertain whether the appearance of the tongue would aid us in our diagnosis and prognosis.

The conclusion that we have arrived at is that the tongue *does* aid us, and while patients who are progressing favourably may present many different varieties of tongues, still, the tongue alters in a fairly well-defined manner when the patient is becoming septic.

In examining a tongue the following points should be observed and entered in the notes: Disease. Age. Time of observation. Temperature. Pulse. Shape of tongue. Coat. Colour. Fungiform papillæ. Filiform papillæ. Dryness. Amount of saliva.

We usually make a simple diagram, and represent the tongue shaped like the letter U. A line down the centre represents the median furrow. The fungiform papillæ are denoted by small circles, while the coat is indicated by lines. Thus, if the coat be not well marked, the tongue being, as Dickinson* terms it, 'stippled,' we draw lines from the median line forward and outwards. If the coat is more marked (second degree), we draw another set of lines across the first, from without inwards and forwards. If, however, the coat is still more marked, we add a third set, which run parallel to the median furrow.

* Dickinson's Lumleian Lectures (*Lancet*, vol. i., 1888) have aided us very much in clearing up many points in connection with our observations on the tongue.

The following diagram will explain this plan:

Disease.	Ectopic pregnancy.
Age.	Thirty-two years.
Time.	Forty-eight hours after section.
Temperature.	100° F.
Pulse.	96.
Shape.	U-shape.
Coated.	Third degree.
	Tip. Red, clean.
	Sides. Red, clean.
Colour.	White-yellow.
Fungiform.	Very red conspicuous through coat.
	Very conspicuous at tip.
Filiform.	Not distinct.
Dryness.	Tongue is moist.
Saliva.	Medium amount; can spit.

The Stippled Tongue.

This is the tongue most frequently seen when the case is progressing favourably. It is, in fact, but slightly altered from the tongue of health, and we may take it as a convenient

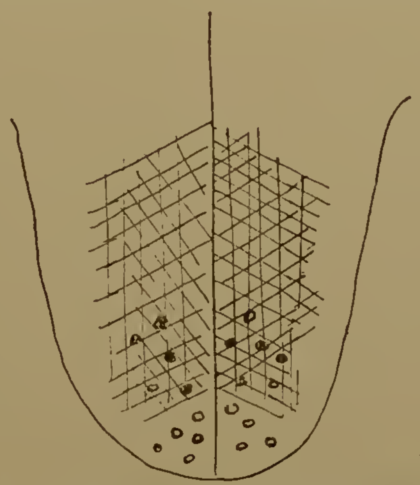

Fig. 126.—Diagram of the Tongue.
The cross-lines represent the coat; the small circles the fungiform papillæ.

standard to which we may compare the other tongues presently to be described.

In shape the tongue is broad and flat; the tip is rounded, not pointed. It is moist, and although the saliva may be somewhat diminished, and the patient may be suffering from thirst, yet if she is asked to spit into a band-basin she can do so readily.

The filiform papillæ are separately capped with white specks, but the fungiform papillæ at the tip are not conspicuous, and

they may be seen here and there as light-red spots. The sides of the tongue are clean, while there is a clear triangular space at the tip, the apex of the triangle pointing towards the back of the tongue.

The tongue taken as a whole presents a moist, thin, gray coat with a pale pink background, the sides and tip being clean.

With such a tongue the pulse is usually not above 100, and the temperature ranges between normal and 100° F. If, however, the temperature increases during the next few days, and the pulse shows that the patient is progressing favourably, the 'stippled' or 'dotted' tongue may then become the **stippled and coated tongue**, or if the coat be continuous it becomes the **coated tongue**; if the coat be very thick, it becomes the **plastered tongue.**

If, however, the patient is not progressing favourably, and peritonitis develops, then at the end of forty-eight hours we find that the tongue has changed to the **clean, dry, glazed tongue.**

The Stippled and Coated Tongue.

The variation in appearance of the stippled tongue from the tongue of health is due to an alteration in the amount and deposition of the epithelial covering. So also the appearance of the stippled and coated tongue is due to the accumulation of epithelium and parasites—mostly micrococci—on the filiform papillæ on the anterior portion of the tongue, where the spaces between the papillæ are not filled in; the tongue then presents a stippled appearance, while the tip and sides are clean. The posterior portion, however, shows that the spaces between the papillæ are filled up, and so we get the appearance of a more or less continuous coat, the change being due to the fact that the papillary processes are elongated.

The Coated Tongue.

With the coated tongue we have the signs of epithelial excess, due either to retention or overproduction.

We see this tongue not unfrequently on the third or fourth day, when the patient is progressing favourably; generally there has been a rise of temperature (100°-101° F.) when this coat is present. There is not much saliva, and the patient suffers from thirst; nevertheless, the tongue is far from being dry.

The coat here is continuous between the papillæ, and consequently the stippled and dotted appearance no longer exists; but we may notice at times the red fungiform papillæ which are prominent at the tip, where a clear area still remains, and we may also notice these papillæ scattered over the tongue, projecting as red points through the coat.

The colour of such a tongue is gray when the coat is thin, yellow and white in the centre and back of the tongue when the coat is thicker.

If the patient has taken black coffee, the coat is stained brown; if the patient vomits much bile—which is not unfrequently done with this tongue—the coat assumes a yellow or an olive-green appearance, as the moist coat stains fairly easily.

This tongue implies that there is no particular failure of vitality, the distribution of the blood is not much disturbed, and epithelial production is continued in the mouth.

The Plastered Tongue.

In women who suffer much from indigestion, whose teeth are not good, and whose breath is foul before the operation, we often encounter towards the end of the first week a large flat moist tongue. The coat is white and moist, and the whole tongue is covered except the tip and sides. The red fungiform papillæ may be seen at the tip and sides, and may protrude through the coat as it thins towards the tip and sides. The tongue does not tend to become brown and dry, as it does in very acute diseases such as typhoid and pneumonia; after four or five days it usually begins to clean from before back.

This plastered tongue may be considered as a further stage of the coated tongue, its appearance being due to an increase in the length of the papillæ and a more complete filling up of the intervals, together with the accumulation of epithelium and micro-organisms.

The patient has usually had some pyrexia (101°-102° F.), and it is not unusual to find that along the edge of the tongue there are small ulcers, and these cause the patient great pain. If there are no ulcers there may be tooth-marks on more than one spot.

This tongue denotes disuse, and the coating tends to increase because the patient is unable to take any solid food.

Patients who have this type of tongue have, as we have

already remarked, very often bad teeth; they suffer from chronic dyspepsia and marked flatulence, and their breath is usually foul. The milk diet of the first week after the operation seldom agrees with them; it appears to make the tongue more coated, and the patients complain that the milk gives them a metallic taste in the mouth.

The Furred Tongue.

This type of tongue is, in our experience, seldom encountered after a section. Should we happen to see a dry, furred tongue during the first two days after the operation, then we may be certain that it did not change from a clean tongue to a furred one since the operation; the tongue must have been furred, or almost so, at the time of the operation. In fact, we have very rarely seen a furred tongue during the first week following the section; if we encounter it, it is at a later period.

The peculiar appearance of the furred tongue is due to the change in the filiform papillæ; these increase very much in size and become greatly lengthened, so that they stand out conspicuously.

We encounter this tongue occasionally when the patient is suffering from septic trouble which has gone on for some weeks. The tongue is usually dry, and there is a marked deficiency in the quantity of saliva. The furred condition is no doubt largely due to disuse and want of moisture; the papillæ become hard and dry and resist the feeble friction movements of the tongue of the debilitated patient.

If we operate on a case with a furred tongue, we generally have to deal with a collection of pus, and if the tongue clears up after four or five days it is a good sign. If, however, peritonitis sets in, then we get a narrow, dry, brown, furred tongue, and this is generally a fatal sign.

The Clean, Dry, Glazed Tongue.

The tongue of health is the broad, moist, U-shaped, stippled tongue. Occasionally, however, we see a case where the tongue is quite clean, very red and moist, and the patient is in good health. Such a tongue is rare in health, and we have noticed it only once after a section.

When, however, we contrast this clean tongue with the clean

tongue so frequently seen in cases with peritonitis after a section, we notice the following points:

The tongue in health is clean, broad, and has a rounded **U**-shaped tip, and, above all, it is moist.

The tongue of peritonitis is clean and narrow, with a **V**-shaped tip. The surface is apparently quite devoid of filiform papillæ, but at the point, and here and there on the surface, the fungiform papillæ may stand up quite dry, but not injected with blood. Across the tongue a crack here and there is noticed, and sometimes the cracks split the surface up into squares so that it resembles crocodile hide. The tongue is not red, it is pale and dusky, and it may be tinged with yellow. Its great feature is its dryness; it is absolutely dry. It has no sign of 'rawness,' for it is covered by a thin, dry, translucent membrane, and it is as smooth as if it had been covered by a thin coat of varnish. We always allude to it as the 'parrot' tongue, because it is as smooth and as dry as the tongue of that bird.

If a patient with such a tongue is asked to spit into a hand-basin, she is quite unable to do so; she may be able to hawk up a little mucus from the throat, but it is evident that the salivary secretion is almost absent.

When the trouble is beginning, the whole tongue does not usually become clean at once. We first notice that the tongue becomes clean and glazed in a strip down the centre. On either side of this strip a stippled area is left, while the sides and tip become clean. The tongue changes as a whole from the pink colour of health to a darker shade with a slight tinge of brown in it.

This type of tongue is always to be regarded with apprehension, and young surgeons are sometimes misled by its clean appearance. Whenever we see this type of tongue, we look upon it as the signal for active purgation.

The Colour and Dryness of the Tongue.

Before we are in a position to draw some conclusions from our examinations of the tongue, we must study its colour and dryness.

Colour.—After the majority of sections, the tongue is a delicate pink colour, shaded by the light gray of its stippled coat.

If there has been much hæmorrhage during the operation, or if hæmorrhage takes place after the operation, then the tongue becomes very pale, the gray, stippled coat becomes more opaque and white, the sides and under-surface have a blue tinge, and the veins on the lower surface of the tongue appear a very dark-blue colour. This bloodless condition of the tongue corresponds with the pallid state of the conjunctivæ and lips.

After shock the tongue is pale, but does not present the white, anæmic look found after hæmorrhage; it is frequently stippled, and when felt by the finger appears moist. But, what is most characteristic, it feels as though it had been washed with cold water, and is usually distinctly cold.

If the patient has been given coffee, the tongue is often stained brown, while if she has vomited bile for any length of time it may be stained.

Usually, however, during the first few days the vomited matter does not stain the tongue appreciably.

When the patient is not progressing well the colour of the tongue after the first few days changes, the pink colour is lost, and the tongue may grow pale or dark, but it rarely—at all events, during the first week—becomes brown; when it does it is because the white coat has become very dry. So long as a coated tongue continues moist it does not become brown; once, however, deprived of saliva, the tongue becomes dry, and the degree of dryness largely influences the shade of the coat.

Dryness.—When we ask a patient to show her tongue, we run our finger over its surface to rightly gauge the degree of moisture or dryness.

A moist tongue is a favourable sign, a dry tongue always causes some anxiety.

If we enter the patient's room soon after she awakes from a sleep and examine her tongue, it will usually be found dry, even if she is progressing favourably. This dryness is due to the fact that the saliva ceases to flow during sleep, and some patients sleep with their mouths open, and thus allow of increased evaporation; the dryness is increased if there is fever, on account of the expired heated air passing out over the tongue. But between a patient who is progressing favourably and one who is in danger there is this marked distinction, that if we ask the former to roll her tongue about her mouth for a short time we find that it soon becomes moist and its appearance becomes

changed, while in the latter case no effort on the part of the patient will cause the tongue to become moist or to alter appreciably in appearance. In the one case the saliva flows, even if the quantity is diminished; in the other case the saliva is so scanty that it is not sufficient to moisten the surface.

With the smooth, dry tongue of peritonitis no doubt the loss of the superficial epithelium—which is conservative of moisture—greatly facilitates evaporation and desiccation.

A rise in the patient's temperature tends to cause some dryness of the tongue; and the administration of opium, by checking the flow of saliva, also tends to make the coat dry and coated.

We may conclude that the dryness of the tongue after a section depends mainly on a deficiency of saliva, and the deficiency is most marked in patients whose condition is becoming, or has become, serious.

It is to be noted that a deficiency of saliva at one time will tend to the tongue becoming coated, at other times to its becoming smooth and dry. For instance, in the case of peritonitis the tongue is dry and smooth, and the saliva is markedly diminished. Here the smooth, dry tongue is the result of a deficiency in the quantity of saliva and a failure of nutrition.

What the Study of the Tongue after a Section teaches us.

Dickinson truly observes: 'The tongue is an index of constitutional states, seldom of individual diseases. . . . The tongue, indeed, has a whole book of prognostics written upon its surface.'

After a section the tongue may be absolutely clean and moist; more frequently, however, it is stippled, coated, or plastered, while sometimes it becomes dry and bare.

If the tongue when protruded is U-shaped, and is at the same time moist, stippled, or coated, or even plastered, during the first three days after the operation, the patient as a rule is in a favourable condition.

We look with particular favour on a tongue which is U-shaped and moist, has a clean tip with a few fungiform papillæ distinctly seen, and has two bands of silver-gray stippled coat on either side of the median furrow.

If the tongue is very anæmic and cold, the patient has either lost much blood, or is suffering from secondary hæmorrhage.

The tongue that is always to be looked upon with grave sus-

picion is the dry, clean tongue, here and there split up into squares so as to resemble crocodile-hide. When the patient protrudes this tongue it is no longer **U**-shaped, but pointed and **V**-shaped.

Even if there is only a smooth, dry strip down the median furrow, and this is bounded on either side by a strip covered by a coat, this is still an unfavourable tongue; it is progressing towards the wholly clean, dry, glazed tongue—*i.e.*, the 'parrot' tongue, which is the tongue of peritonitis and pseudo-ileus. The 'parrot' tongue is the herald of death.

Dryness of the tongue is an unfavourable sign when the patient cannot by an effort raise sufficient saliva to moisten the surface and alter its character. The deficiency of saliva then indicates a failure of nutrition and of the vital powers.

CHAPTER XXX

DRAINAGE

WHETHER we are to drain or not is a matter to be considered during the course of the operation: it is not part of the after-treatment; we have only to consider here the management of the tube, or gauze, when used for drainage.

The Glass Tube.

Ten years ago the glass tube was used extensively, to-day it is conspicuous by its absence; still, it is used, and often with brilliant results, in cases where suppurative peritonitis is present at the time of the operation.

The tube most usually employed is Keith's. It is inserted into Douglas's pouch, and is fixed so as to project from the lower angle of the abdominal wound, where it is surrounded by the dressing. Usually a piece of rubber tissue is slipped over the collar of the tube, and a piece of absorbent cotton, or a sponge, placed over the end of the tube, the whole being surrounded and enclosed by the rubber tissue; the dressings are thus saved from being contaminated. If there be considerable oozing from raw surfaces, or if the abdominal cavity has been irritated, a considerable quantity of fluid drains away during the first hours that follow the operation.

If the drainage-tube is employed because of hæmorrhage, the nurse must begin to empty it as soon as the patient is made comfortable in bed.

To do this the bedclothes are drawn aside opposite the tube, the patient being exposed as little as possible, lest she should become chilled. The band of the binder that crosses the tube is loosened, the rubber tissue is unfolded, the sponge or cotton removed, and the piece of gauze which is placed in the tube to act as a capillary drain is drawn up with forceps.

A piece of rubber tubing—with an eye cut ½ inch from the distal extremity—attached to an ordinary glass syringe, or to Tait's special exhauster, is now pushed down to within an inch of the bottom of the tube, and the blood-stained fluid is slowly sucked up into the syringe. The rubber tube is then withdrawn, and the fluid is forced into a measure glass. The above process is repeated until we can no longer suck up any fluid.

A piece of fresh gauze, or a sterile lamp-wick, is now inserted into the glass tube, and is pushed down by means of a clean probe, so as to act as a capillary drain; the sponge is placed over the end of the tube, the rubber tissue is replaced, and the band of the binder is drawn sufficiently tight to prevent the tube being forced out when the patient vomits, but at the same time it is not so tight as to force the tube down on to the bowel.

After using the syringe some weak carbolic lotion (2 per cent.) should be sucked into it, and all the blood-stained fluid completely washed out, after which it should be immersed in a basin of carbolic lotion.

Before inserting the rubber tube again into the drainage-tube it should be dried on a piece of sterile gauze. The nurse must be most particular that her hands have not been contaminated in the intervals between the passages of the tube. She should also take the precaution of wiping the proximal end of the glass drainage-tube with a piece of cotton-wool, held by a pair of sterile forceps, before inserting the rubber tube.

If the fluid withdrawn be very bright in colour, the syringe may be used every fifteen minutes so as to remove the blood and serous fluid, for bleeding is 'encouraged after division of vessels in the abdominal cavity by their being bathed in abundant thin serous fluid. Keeping the abdomen dry permits of clotting, and thereby promotes hæmostasis' (Greig Smith).

The length of time that the drainage-tube should remain in will vary with each case. If the fluid withdrawn is very bright, it indicates that persistent oozing is going on, and therefore it will be well to allow the drainage-tube to remain until either the fluid is very much reduced in quantity, or has become quite pale in colour. From twenty-four to forty-eight hours was the time that we used to allow the tube to remain, but in cases where suppuration was present we have allowed it to remain for seven days, and after withdrawing it have inserted either a rubber tube or a wick drain.

There can be no question that the tube should not be allowed to remain one moment longer than is absolutely necessary, for every hour that it remains means that the patient is exposed to the risk of infection from without, and the tube, by separating the aponeurosis of the recti muscles, leads to healing by second intention, and causes a weak spot, which lays the foundation for a future hernia.

When the time comes for removing the tube, the skin surrounding the tube should be cleansed with some pure peroxide of hydrogen, and if the wound has been dusted with boracic powder, or with iodoform, these should be removed from the immediate neighbourhood of the wound, lest any of the powder should fall into the peritoneal cavity on the withdrawal of the tube.

To withdraw the tube we should proceed thus: The proximal end is seized and twisted round and round, and then gently pulled up. As the apertures in the side come into view we must notice if the omentum has forced its way into the holes. Sometimes quite a large piece will be found in the lumen of the tube, and it is impossible to withdraw the tube until we have passed a catgut ligature, by the aid of a needle, through the uppermost part of the omental tissue outside the tube, and then when this has been carefully snipped through another ligature is introduced and tied, each section of the omentum being dealt with as it appears until the tube is at last freed. On no account should the omentum be snipped through without inserting the ligatures.

Although the glass tube is now out of fashion there are some careful surgeons who continue to use it, and we think that it is sometimes better to use a glass tube than a rubber one in those cases where we reopen and wash out the abdominal cavity for septic conditions.

It is well to note a few points in connection with its employment:

1. Too much care cannot be exercised in keeping the syringe and sucker aseptic, as the rubber tube is a ready means of introducing infection, and pelvic suppuration or even general peritonitis may be the result of any carelessness on the part of the nurse.

2. If the tube has but a short stem above the collar at the proximal end it may slip into the peritoneal cavity. Should

this accident occur, the patient should be given an anæsthetic and one of the stitches removed; then one finger is inserted and the tube located, after which a long pair of forceps can be slipped down and the tube seized and withdrawn.

3. The tube has been known to break while the patient is vomiting or straining. The upper part should be withdrawn, and the lower part may be removed by an incision into Douglas's pouch by way of the vagina. We have known this accident to happen to Mr. Tait, and that was the course he adopted. Malcolm on the fourth day discovered that a glass tube was broken, and opened the abdomen and recovered the broken piece, catching it with a pair of forceps covered with rubber tubing. Cripps left a broken tube in the abdominal cavity, and it gave rise to no trouble.

4. The band of the binder that crosses over the proximal end of the tube has been drawn so tight that the tube has been forced down on the bowel, and perforation has resulted. Cripps says: 'I believe that the tube occasionally presses against some loop of bowel and gives rise to partial obstruction. In one case where considerable abdominal pain and distension accompanied some nasty retching on the evening of the third day, the symptoms completely disappeared on removal of the tube, and soon afterwards the patient passed a considerable quantity of wind, which she had not done previously.'

5. While the tube remains in the abdomen the nurse should frequently turn it round so as to disengage any omentum that happens to find its way through the perforations in the tube. Once a piece of omentum enters the tube, the arterial blood finds its way into the small hernia readily; but the veins are compressed at the perforation, and consequently the tissues swell, and more and more of the omentum is pulled into the lumen of the tube.

6. If it be found expedient to change the tube, a long glass rod should first be introduced down the tube that is to be withdrawn, so that the new tube can be guided into the track of the old.

Gauze Drainage.

Gauze drains are much more often employed now in pelvic surgery than glass drains. These are of great use when we are unable to control oozing from the raw surfaces from which we have stripped off a tumour or a tube.

Gauze is now extensively used to wall off the general peritoneal cavity from an abscess cavity in the pelvis, while in cases of diffuse septic peritonitis, after the abdomen has been reopened and irrigated, gauze prevents the bowels prolapsing, while at the same time the cavity is being drained by its presence.

The end of a gauze drain may lie in contact with the sides of the abdominal wound, but some surgeons are accustomed to wrap a piece of rubber tissue around the gauze, and this prevents it adhering to the sides of the wound. These drains may project either from the lower end of the abdominal incision, or they may be brought out into the vagina.

They are usually left in for thirty-six hours, but frequently we have left them for four or five days, because it is easier to withdraw them after the third day than during the first two days after the operation.

If the patient happens to be a nervous woman, or if she is run down, it will be better to give her a little chloroform whilst removing the drain, for it is a very painful ordeal, particularly when we pull on the gauze first of all, before it begins to come out with freedom. Not unfrequently the omentum will be pulled up, and being yellow in colour, it may not be noticed at first if the light is bad. As this accident may happen, no matter how carefully the gauze is withdrawn, we should always, before withdrawing a gauze drain, take the precaution to sterilize our hands so that we may push the omentum back and hold it down while we bring the edges of the incision together, otherwise the omentum will be caught between the sides of the incision.

To remove a gauze drain we proceed thus: The binder and dressing having been removed, the skin about the incision is washed and then rubbed with peroxide of hydrogen. The protruding end of the gauze is seized by the right hand, while the fingers of the left are placed on either side of the wound so as to exert counter-pressure when the gauze is pulled upon. The first pull is usually the most painful for the patient, as the gauze is adhering to the sides of the incision. Once the gauze starts to come out it is pulled up slowly, care being taken to rotate it. Usually dark-stained serum is squeezed out of it as it emerges from the wound, and the nurse should stand by with a number of tupfers to mop up the serum.

If the gauze has been packed in to control hæmorrhage, and we find after taking out 12 or 18 inches that there is an escape

of bright blood, it will be wise to cut off that portion of the gauze already withdrawn, and defer the removal of the drain, lest the hæmorrhage should start afresh. Again, if we find pus on the gauze on withdrawing it, the drain should be allowed to remain until the fourth or fifth day from the time of operation, so that sufficient adhesions will form to cut off the septic focus from the general peritoneal cavity.

When the gauze is evidently septic one should not leave the protruding end to lie on the skin, as this will only lead to stitch abscesses. It is better to carefully enclose the end in iodoform gauze, or in sal-alembroth gauze, and then to wrap a piece of rubber tissue round the whole and paint the skin with collodion.

If the case is one in which we have walled off a large pelvic abscess, it may be necessary to leave the gauze drain for a week, or even more, until we are certain that adhesions have shut off the septic area.

We not unfrequently find that little or no fluid is being drained away by the gauze, the protruding end being quite dry. The reason for this is that the gauze strand has been made too thin, consequently the muscular walls of the incision contract on it and constrict it. When this is the case the loosening or removal of one or two sutures next to the gauze, and the opening of the wound with a probe, will give the requisite freedom. Should the gauze be drained through an opening in the loin it is a good plan to draw it through a metal tube shaped like a straight tracheotomy tube, for this prevents the muscles of the loin closing on the gauze.

In employing gauze drainage we must not forget that if the patient vomits much a coil of intestine may be forced out by the side of the gauze. Therefore, at the time of the operation, two silkworm sutures should be inserted near the drain, and these should be loosely tied, so that when the gauze is withdrawn they may be tightened up. To neglect this precaution is only to court a future hernia.

If instead of a strip we have employed Mickulicz's gauze bag, then the strips of gauze are withdrawn in the reverse order in which they have been packed into the bag, and the latter is withdrawn by pulling on the central cord so as to turn it inside out, care being taken that a piece of intestine or omentum does not immediately protrude after the bag is withdrawn.

If the drain has been brought out by way of the vagina, we

can remove the gauze usually on the third day. The easiest way to effect this is to bring the patient to the edge of the bed and turn her on to her left side, placing her in Sims' position. A long thin speculum is passed, and the gauze comes into view by the nurse, who stands on the opposite side of the bed, holding a small electric light near the orifice of the vagina, while at the same time she pulls up the right buttock. The gauze is then seized with a long pair of dressing forceps, and it is gradually withdrawn. This usually causes little pain, and an anæsthetic is not required. After removing the drain the vagina is mopped out with weak peroxide of hydrogen, then with normal saline fluid, and a fresh piece of gauze is inserted and packed well into the vault of the vagina, but not through the incision into the pouch of Douglas, unless we are draining a pelvic abscess and we wish to keep the opening into the vagina patent.

Rubber Drainage-Tubes.

Rubber tubes are chiefly employed after sections for diffuse peritonitis, the tubes being brought out through the abdominal wound, through the vagina, or the loin. The only special care that such tubes require is to see that they are not choked or pressed upon by the muscular walls so as to obliterate their lumen.

If rubber tubes are used in septic cases to help to drain Douglas's pouch they should be prepared by first being boiled, then by being placed in a saturated solution of iodoform in ether for one hour, and then soaked in pure alcohol for twenty-four hours.

CHAPTER XXXI

CARE OF THE WOUND—REMOVAL OF STITCHES

After clean operations, where we have not employed drainage, the wound need not be inspected during the first week; especially is this the case when we have closed the incision in layers, and have used the subcuticular suture.

If we have employed silkworm gut and through-and-through sutures, in septic cases we may inspect the wound on the fourth day, or sooner, to see if there are any signs of suppuration.

Where a glass or a gauze drain is employed, we must endeavour, by means of protective tissue, to prevent the fluid from flowing over the rest of the wound. Probably the most difficult case to keep sweet is one in which the pedicle of a fibroid, or of a uterus, is fixed in the lower part of the incision, as in Porro's operation.

The chief aim in such cases is to keep the stump as dry as possible, and this is done by constantly changing the dressings, and by the free use of boracic acid.

After clean operations the dressing is frequently soaked with blood; this dries after twenty-four hours, and forms a firm, adhesive dressing, and there is no occasion to remove it. In hot weather a peculiarly disagreeable smell may arise from the dried blood—it smells, in fact, like a glue factory. The smell is always an indication that everything about the wound is satisfactory; it only arises when there is absolute dryness.

If there is any indication that the dressings are becoming moist on the second or third day, they should at once be changed, and the wound should be inspected every day.

If the sutures used for closing the abdominal incision are of silk, some should be removed on the seventh day and the rest on the following day.

We used silk in over one hundred sections, and although we

seldom had stitch abscesses we frequently had a little moisture on removing the sutures; we were, however, seldom able to leave these sutures in longer than the eighth day without trouble, and we accordingly abandoned silk for silk-gut sutures, which we usually do not remove until the fourteenth day. If, however, after the seventh day we see any halo of redness appearing around any of the sutures, and the patient complains of any pain when the side of the wound is pressed by the point of the forceps, we immediately remove the suture in the neighbourhood of the trouble.

Occasionally we observe a bleb of fluid by a suture, and this is generally an indication that the suture has been tied too tightly; such sutures should be watched and removed first, or they will cause trouble.

When the surgeon intimates to the nurse the day on which he intends to remove the stitches, she should have in readiness two large flat trays, the one to receive the soiled dressings, the other to contain the fresh dressing, wrapped in a sterile towel, also a fresh binder, two towels, a box of safety-pins, and some iodoform and boracic acid. She should also have some swabs in a glass jar, while in a kidney-tray she should have a pair of sharp-pointed sterilized scissors and a pair of forceps, and neai at hand should be a roll of Mead's adhesive plaster.

When the surgeon is ready the nurse folds the bedclothes down as far as the pubes, and tucks the night-dress up on the chest, after which she spreads one of the towels from her tray over the epigastric region, and the other over the bedclothes and pubes. The dressings are now removed with a pair of forceps and are placed on the second tray, and the binder is also slipped from under the patient.

In removing a suture one of its ends is seized, and traction is made so as to expose some of the strand that has been hidden in the tissues. When this is exposed—it is whiter in colour than the part about the knot—the points of a pair of sharp-pointed scissors are slipped on either side of the suture, and are pressed down so as to expose and cut the portion of the suture that has been buried in the tissues. The knotted end of the suture is now pulled across the wound towards the side on which the suture has been cut through.

If the suture is pulled away from the wound, then there is a tendency to burst the edges apart.

On no account should the suture be cut above the skin-level close to the knot, for if this is done we should, in removing the suture, draw the hard, dry, and dirty end of the silk gut along the suture track; this causes the patient considerable pain, and infects the track.

At times the suture will not start when we draw on the knotted end; the best plan to adopt then is to take a second pair of forceps and place the blades of the forceps on the skin,

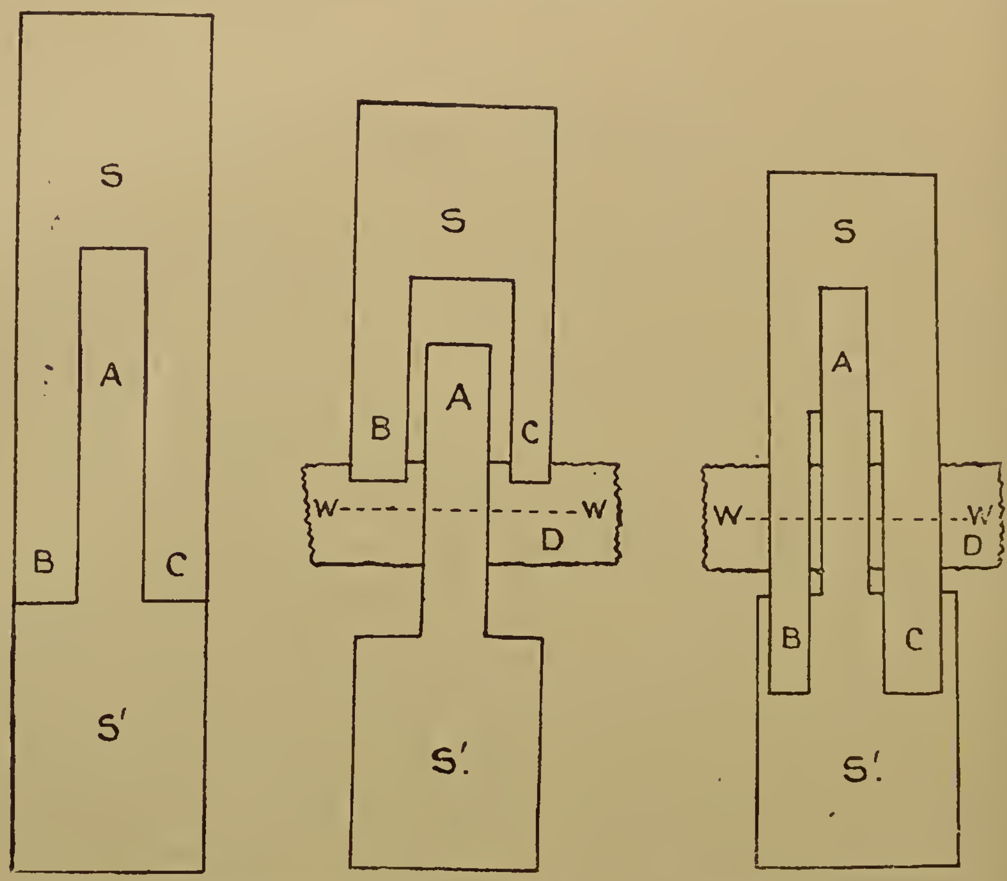

Fig. 127.—Diagrams showing the Method of Applying Plaster over the Dressing on the Abdominal Wound.

one on either side of the suture, and press firmly down while we make steady traction on the knot with the other pair of forceps.

After removing the sutures any scabs of blood that we find in the middle line in the wound may be allowed to remain, but any small, hard, dry scabs around the suture holes may be picked off with the forceps.

A narrow strip of gauze, four layers in thickness, is placed over the wound, and this is kept in position by a strip of plaster, which also helps to support the wound.

Some surgeons do not see any virtue in these strips of plaster; true, they are of little use if merely placed as strips over the dressing, but when placed in the following manner they are of undoubted utility.

A piece of strapping 8 inches long and $1\frac{1}{2}$ inches wide is cut in the manner indicated in Fig. 127. The two pieces are now separated, and are placed on either side of the wound (W), which is covered by gauze (D), and the surfaces S and S′ are made to firmly adhere to the skin. The ends B and C are then seized with the fingers of one hand and the end A with the fingers of the other hand, and A is gradually drawn until it overlaps S, while B and C are affixed to S′.

A layer of cotton-wool is placed over the plaster, and a binding, or belt, is adjusted.

CHAPTER XXXII

STITCH ABSCESSES AND SUPPURATION OF THE WOUND

Stitch abscesses occurred very frequently in the early days of ovariotomy, when the pedicle was treated by the clamp method. Later on, when hysterectomy became common, the extra-peritoneal treatment of the pedicle by the serre-nœud and transfixion pins became a fertile source of stitch abscesses and suppuration in the wound.

The careful preparation that the skin now undergoes and the employment of buried sutures have done much to abolish both these complications; but in spite of every care there will always be a percentage of cases in which suppuration will occur, because skin infection is produced during the course of the operation when dealing with septic cases. This is well illustrated in such operations as appendicitis, and in cases of abdominal hysterectomy for carcinoma of the uterus. In the one instance the infection is so virulent that both the suture tracks and the wound become infected, while in the other case the tissues have lowered vitality from a chronic wasting disease, and therefore offer but little resistance to infection.

Etiology.

The most usual cause for a stitch abscess is imperfect sterilization of the needle or the suture material.

After this comes imperfect disinfection of the skin previous to the operation, and this is particularly seen after imperative surgery.

Contamination of the skin and wound during the operation, or afterwards when employing drainage, and contamination of the sutures by the surgeon's hands after operating on septic cases, are all frequent causes for these complications.

Robb* recently published a report on seventy-two consecutive pus cases, and he says that suppuration of the abdominal wound occurred in twelve cases (18·7 per cent.). In the secretion from the incision in six of the twelve cases Robb was able to demonstrate *Staphylococcus pyogenes aureus*, and he thinks that this was due to the fact that he had previously operated upon a case of post-puerperal infection in which the staphylococcus was found at the time of the operation. In six of the abdominal sections performed during the two weeks following (although he left an interval of four days) the incision became infected, and the *Staphylococcus pyogenes aureus* was found in the secretion.

Tying sutures too tightly has often been advanced as a cause for stitch abscess. If such be the case, and we think it is so, we must suppose that the strangulation lowers the vitality of the tissues, and allows them to become easily infected. It is a wise plan always to regard a stitch abscess as due to a defect in technique.

The employment of silk as a suture material makes infection from without more easy, while the absence of capillarity in silk gut makes that material an almost perfect superficial suture material.

The size of the abdominal incision, and the nature of the tumour removed, are influences in determining suppuration of the wound.

In the one case the sides of the incision become bruised if we endeavour to remove a large tumour through a small incision, or the side of the incision become contused if metal retractors are used with force.

The nature of the tumour influences the result. A tapped ovarian cyst, for instance, does less damage during its removal than a fibroid forced through an overstretched opening, and a pyosalpinx will be more septic than a hydrosalpinx; and consequently the tumour influences the result, because if it is of a septic nature it will contaminate the surgeon's hands, and he will often thus infect his sutures.

Suppuration in a wound is more prone to occur in a fat woman than in a thin woman, because of the liability of a deep space being left in the course of the incision; a hæmatoma easily forms, and this may suppurate, or much serum is poured

* *American Journal of Obstetrics*, August, 1901.

out, and it becomes infected. For the same reason suppuration is not unfrequent after operations for ventral or umbilical hernia, owing to the position of the loose subcutaneous tissues and the impossibility of making adequate pressure (Lockwood).

When introducing sutures by means of a handled needle it is not an uncommon thing to pierce a vein, and a hæmatoma will form around the stitch, and an abscess soon develops.

Suppuration may occur in a wound either because the catgut or wallaby tendon has been badly prepared, or because an unabsorbable material, such as silkworm gut, silk, or silver, has been used. In the latter instances the suppuration may occur months after the time of the operation.

Pathological Anatomy.

Stitch abscesses form on either side of the abdominal wound, immediately surrounding the sutures. The pus may be situated—

(*a*) In the fat and the loose tissue, just beneath the skin, where it causes a swelling and a redness in the neighbourhood of the suture. This pus finds a path to the surface by way of the suture tracks, or it burrows to the median line and discharges through the incision.

(*b*) The pus may form in the rectus, and this swelling is not so apparent unless the pus is in large quantities, when it burrows towards the median line, or it may find its way down along the suture track, and burst into the peritoneal cavity.

(*c*) The pus may occasionally be located beneath the muscle and above the peritoneum, and from this position it may force its way to the median line or into the peritoneal cavity.

(*d*) In some instances, when the incision has been closed in layers, the peritoneum is first secured with a continuous suture, then the anterior sheath of the rectus is sutured. The blood oozing from the rectus collects in the space between these two lines of sutures. If the blood has become infected, there is considerable danger, because the pus, being unable to force its way up, may burst into the peritoneal cavity. If it does force its way to the surface it is discharged as a chocolate-coloured fluid, and we have seen this occur even as late as the third week after the operation.

Symptoms.

The symptoms that attend suppuration along the track of a suture will vary very markedly with the character of the infection.

Usually in a case where there is no drainage-tube the patient complains of no pain until the fourth day, when, after being turned in bed, or after vomiting or coughing, she feels some pain in the neighbourhood of the incision. On removing the dressings a halo of redness will be seen surrounding the suture, and if a probe be pressed on this spot, the patient instantly shrinks and complains of pain. The pus in such cases is usually in the adipose tissue under the skin.

Occasionally every suture is surrounded by red halos, and the spaces in between the several sutures are red, swollen, and shiny, and exhibit here and there small blebs of serum or of purulent fluid.

If the infection has been slight the patient may complain of very little discomfort, and nothing unusual is noticed until a suture has been removed, when a small quantity of pus slowly drains out and stains the dressings.

If the infection has been very virulent, the whole area surrounding the incision may be swollen, and exhibits a dusky-red colour, and here and there the area surrounding the sutures is swollen up so as to resemble a boil. All the surrounding tissues are brawny and red. The patient suffers great pain. On removing a suture thick pus wells out, not only from the suture track, but also from the incision. In such cases the patient may have a rigor, and the temperature is raised two or three degrees, and the pulse-rate is increased to 115 or more.

Suppuration may occur in the course of the incision either in association with stitch abscesses, when the wound has been closed in layers, or after employing a gauze drain.

We have occasionally seen no redness or signs of inflammation around the sutures, but when these have been removed the wound has opened in one or two places and discharged a quantity of thin, chocolate-coloured fluid mixed with pus, and then quickly healed up again. In these cases the suppuration is due to a late infection of a hæmatoma, formed by blood oozing from the tissues or from the perforation of a large vein during the insertion of the sutures. In one instance we observed that fully 6 ounces of this chocolate fluid flowed from a stitch hole after removing a suture.

In these cases where the blood collects in the line of the incision between the peritoneum and the anterior layer of the rectus, the suppuration gives rise to little trouble during the first week. During the second week the evening temperature begins to rise, and becomes higher every evening, and the pulse-rate increases. In one of our cases the patient complained of no pain, and the cause of the rising temperature was not ascertained until a probe had been inserted deeply into the incision, and the sides of the aponeurotic layer parted so as to allow the pus and blood to escape. The catgut that had been used in this case had been bought from a reliable maker, but had not been resterilized. We used it on two other cases; both their wounds suppurated, and in one case the pus burst into the peritoneal cavity and the patient died of peritonitis. Since then we have seldom used any catgut above No. 1 size without sterilizing it ourselves.

Diagnosis.

If after a simple section we find that the temperature does not fall towards the normal after three or four days, but that there is an increased pulse-rate, and the patient complains of pain in the region of the wound, we should at once inspect the sutures. On removing the dressings we may discover that all the skin around the sutures is red, but after exposing the wound to the air for a short time the redness disappears, except around the suture, where the pus is, and if this is palpated with a probe the patient will always complain of pain.

If the blood has been examined from time to time since the operation, it will now be found that the leucocyte count will have increased, and will show 15,000 to 22,000 leucocytes per cubic millimetre. The leucocyte count is an assistance in those cases where the pus is deeply seated between the peritoneum and the muscle. Here there may be little or no swelling at first, and we may not be able to diagnose the condition until the pus has increased very much in quantity; the leucocyte count puts us on our guard.

We may mistake a simple exudation in the abdominal walls for an abscess. Olshausen gives the following instance: 'In cases which go to the other extreme the fever from phlegmon of the abdominal walls does not develop until two weeks after the

operation, or even later. Thus, in a patient whose temperature had remained below 38° C. for six days, and who had not yet left the bed, fever again began on the fourteenth day, rose to 39·7° C., and did not cease until the twenty-first day after the operation. The cause was soon found in an exudation in the abdominal walls in the shape of a hard, tender tumour half as large as a fist. This disappeared rapidly after the cessation of the fever. Absorption, however, is a rather rare exception.'

Prognosis.

Kelly says that in 1,700 abdominal sections in the Johns Hopkins Hospital, three deaths from peritonitis were attributed to stitch-hole abscesses communicating with the peritoneal cavity. Ferguson lost one of his first ovariotomies by the bursting of an abscess into the peritoneal cavity sixteen days after the operation had been performed. As mentioned above, we have lost one case from a similar cause.

Even when the results are not serious the patient suffers great pain from the presence of pus; and as the pus is frequently poured out into the incision, this causes a delay in healing, and strongly predisposes to the development of an incisional hernia by causing the cicatrix to become broad and thin.

We believe that a stitch abscess may be the seat from which a thrombo-phlebitis may start.

Treatment.

Prophylactic.—The preparation of the patient's skin by means of iodic hydrarg. and methylated spirits, and the employment of silkworm gut in place of silk, and the abolition of the drainage-tube, have gone far towards lessening the occurrence of stitch abscesses and suppurating wounds in clean cases.

By closing the abdominal incision in layers we have abolished stitch abscesses, but we have probably increased the occurrence of suppuration of the wound in septic cases, and have made this complication more troublesome, because the suppuration continues longer on account of the buried sutures acting as foreign bodies.

If the patient has a large deposit of fat in the abdominal walls it is a good thing to insert a small drainage-tube for a few days. If this is not done we frequently find that though union by first intention takes place along the line of incision and the skin, yet a large quantity of serum collects beneath this and distends the parts. If, then, about the fourth day we take a pair of sinus forceps and separate the skin incision, we shall immediately find that some drachms of straw-coloured serum will drain away. If, however, this serum is allowed to remain it may become absorbed; but it is very liable to be inoculated, and suppuration will follow.

Late suppuration of the wound may be prevented by not employing silkworm gut and silk. There is less objection to the employment of chromic gut and silver wire.

Operative.—When we find, on palpating in the neighbourhood of a suture, that the patient complains of pain, and when at the same time there is a halo of redness surrounding the suture, it will be well to at once remove the suture. If there are several stitches which exhibit similar signs, we may remove those that appear to require immediate attention; but even if the trouble is extensive we must not remove many stitches before the seventh day, lest the whole wound should burst open. If the redness is not very extensive the removal of the suture will usually bring the trouble to a speedy end, for the pus will drain out of the suture track.

If, however, the suppuration be extensive it may cause great pain and swelling; consequently, after removing the stitch, we must pass a probe down the suture track and gently enlarge it, and then clean the track with peroxide of hydrogen. But this will not be sufficient if the suppuration has occurred in the muscular tissue, or between the muscular tissue and the peritoneum. In such cases it will be necessary to open the abscess* at once and allow free drainage, or the pus may burrow towards the peritoneal cavity, or, becoming locked up, may cause death from its extent.

Although the application of poultices and hot fomentations tends to open up the incision after the sutures are removed, yet we have always found that boracic foments give such marked

* We have in Vienna seen as many as six large incisions made in order to drain extensive suppuration in the abdominal walls after a section.

relief that we always employ them, at the same time taking the precaution to place across the wound strips of Mead's plaster in which holes are cut so as to allow free drainage.

Whenever it becomes necessary to open an abscess the patient should be given a little chloroform, for we have found (from personal experience) that freezing a suppurating point is a very painful process.

CHAPTER XXXIII

REOPENING OF THE ABDOMINAL WOUND

Etiology.

The wound may reopen after a section from septic trouble or from mechanical causes.

In many of the cases in which this accident happens the wound has become infected, and has not united by first intention, so that, when the stitches are removed, the wound bursts open after some sudden exertion. Many instances have been recorded where the accident followed a fit of coughing or vomiting, but it may occur even when the patient is not exerting herself. Jahreiss reports a case where he removed the sutures on the ninth day when the wound looked healthy. Six hours later the patient was awakened by an attack of abdominal pain, and it was found, on removing the abdominal binder, that the whole wound had parted, and coils of intestine and omentum protruded. Olshausen says that in one case where the sutures had been removed on the eighth day, and an adhesive plaster dressing applied, the patient left her bed on the eleventh day and sat on a vessel and strained; the upper half of the wound at once ruptured, and a part of the omentum prolapsed. He also relates that whilst transferring a patient from one floor to another of the hospital on the twelfth day the wound ruptured.

In one of Greig Smith's cases he blames the silkworm gut for the accident. The incision extended through the umbilicus, and the gut cut clean through the tissue and permitted the bowels to protrude.

Too early removal of the stitches predisposes to this accident, and it happened to Spencer Wells twice after removing the stitches on the fifth day.

While the accident may be solely due to mechanical causes, we think that Kaltenbach was correct when he said that, as a

general rule, it results from infection of the edges of the wound, which have not healed by first intention, and from tympanitic distension of the abdomen when septic peritonitis is present.

In two of Spencer Wells's cases septicæmia was present. In one of them the accident occurred on the third day after the operation; 'the lower part of the wound gave way and a knuckle of intestine protruded; a good deal of fœtid serum also escaped.' The patient died of septicæmia on the seventh day.

In a case of Cæsarean section recorded by Foreman, of Sydney, the stitches were removed on the eighth day, and the wound reopened and the bowels prolapsed; the patient died on the eleventh day, and it was found that the ascending colon was gangrenous, and there were other signs of septic trouble.

In some cases all the layers of the abdominal wall may part except the peritoneum. When this occurs it is generally due to suppuration; the stitches slowly cut their way out and allow the skin and muscles to gape. Tait relates a case where, after ovariotomy, the friends fed the patient on biscuits and port wine, and, as a result, she vomited for twelve days. 'At the end of that time the wound—an exceptionally large one, for the tumour had been practically solid—was widely open, and I had fished out, bit by bit, sloughs of what seemed to be the whole of both recti muscles. When the vomiting stopped there was a sheet of peritoneum about 8 inches by 6 inches, under which the intestines could be seen wriggling.' The wound slowly healed and the patient recovered, but a large hernia formed.

Harrison Cripps says that after one of his abdominal sections the wound held the first fortnight, then gave way, and there was a large gap between the edges of the skin. This gap was apparently occupied by a coil of intestine covered with granulations, and peristaltic movements could be seen in it.

Nussbaum in his sixteenth case of ovariotomy removed the sutures on the twelfth day; no union had taken place, and the abdominal wound was still wide open, bringing into view the bladder and uterus. The intestine was attached to the diaphragm in one mass. The patient lived thus forty-six days (Peaslee).

A. Gibson (*Canada Pract.*, September, 1901) reports the case of a rupture of the abdominal wound at the cicatrix of a section done ten years previously. The patient was at stool, and while pressing on the abdomen to facilitate the passage of fæces the

abdominal wall gave way at the cicatrix, and the intestine protruded. There was considerable bleeding, and the patient died in fifteen hours.

Treatment.

When, as the result of suppuration, the skin and muscles separate and leave a gap, the apex of which is formed by the peritoneal coat, we should draw the edges together with bands of Mead's plaster. If, however, the gap is of considerable length it will be safer to introduce a few mattress sutures of silkworm gut through the skin and upper layer of the rectus sheath, drainage-tubes being inserted to insure the escape of the pus, and the whole may be covered with boracic acid fomentations, and afterwards dressed with an emulsion composed of ½ drachm of Friar's Balsam to 1 ounce of castor-oil. This emulsion is very soothing, and rapidly cleans a septic wound.

Should the wound in any case suddenly give way, and the intestine protrude, the nurse should at once wrap the prolapsed bowels in a clean towel, which is changed as soon as possible for some sterile gauze which has been wrung out of hot water.

When the house surgeon, or the surgeon himself, arrives he should proceed to insert a gauze sponge between the intestines and the sides of the wound, after which every part of the bowel should be thoroughly washed in hot saline solution, and then with pure peroxide of hydrogen. The bowel should then be returned into the abdominal cavity. If, however, the patient is suffering from peritonitis, and a considerable length of intestine has prolapsed, the best course will be to remove the patient to the operating theatre, and then proceed to empty the bowel, either by puncturing it with a trocar or by a small incision. The bowel may then be more easily returned, and the whole peritoneal cavity should then be irrigated and drained.

The prognosis in these cases is always grave, because the accident seldom happens unless the wound is septic, or unless peritonitis and extreme tympanites is present. In the former case, the bowel may become infected by contact with the sides of the incision; in the latter case, the patient may be already dying of the peritonitis, and this accident hastens her death by shock.

Many cases, however, are recorded where the patient has recovered after this accident.

In one case where we saw a patient of a colleague two days after a section had been performed, we found a large piece of omentum protruding. This was due to the upper part of the wound being open, no sutures having been inserted in the upper angle of the incision. We tied off the protruding omentum and closed the incision. The patient recovered.

CHAPTER XXXIV

SHOCK

Every operation in which the peritoneal cavity is opened is accompanied by some degree of shock. In short and simple operations, such as hysteropexy, the shock is so slight that it has little effect on the patient; but when the operation is a severe and prolonged one, the patient exhibits a train of symptoms which calls for the most attentive study. In fact, we consider that the study of shock is the most important matter in connection with the after-treatment of section cases.

Theory of Shock.

It is impossible at present to give a satisfactory definition of shock, because our knowledge of its pathology is very imperfect.

At present we are content to say that the man who receives a blow on the epigastrium and drops dead, and the boy who is struck by a stone on the larynx and expires immediately, both die of shock; so also do we frequently say that the woman who undergoes a prolonged section and lives twelve or eighteen hours, and then expires, dies from shock. To class such widely different cases under one heading simply implies that we are merely using a general term to embrace phenomena whose pathology may be essentially different.

With regard to the particular variety of shock that we are called upon to study in connection with cœliotomy, our present knowledge tends to show that one of the most striking of the phenomena in connection with it is the impairment or the breakdown of the vaso-motor mechanism.

We know that during the course of a section the manipulation of the intestines, uterus, and ovaries causes a stimulation of the sensory nerves which call forth the pressor mechanism, with a result that the blood-pressure is somewhat raised, and the

heart is slowed by overstimulation of the inhibitory apparatus which governs it. As the manipulation and exposure is continued, the pressor mechanism becomes gradually exhausted. This exhaustion, as many experiments have shown, is evinced in the abdomen by a dilatation of the abdominal veins.* These veins are stated to be capable of holding a large portion of, if not all, the blood of the entire body, so that the result of the paralysis and dilatation of the abdominal vessels is a fall of blood-pressure in the arteries of the body. The heart beats more quickly and the pulse-rate is increased, not because the heart itself is exhausted, but merely because sufficient blood is not supplied to the right side of the heart, and consequently too little is expelled from the left side to fill the arteries.

There are some who consider that the above hæmo-pathological theory is not a sufficient explanation of the phenomena of shock. They argue that the molecular motion that constitutes nerve force is always more or less affected in every species of shock, and consequently that the impairment of reflex action, and the loss of proper impulses from the higher centres, are not the secondary effects produced through the alteration in the circulation, but that they are primary effects due to some chemical change in the centres and nerves which results in an exhaustion—*i.e.*, a decrease of irritability—and the circulatory mechanism is thus thrown out of gear. Consequently, while we may in the first instance have paralysis of the vessels in the splanchnic area only, alteration in the nerve cells of the higher centres leads to a widespread and general vasomotor paralysis.

We may suppose that in health the pressure in the carotid artery is maintained at practically a constant height by the tone of the splanchnic arterioles and the action of the respiratory muscles. A sudden fall of arterial tension always provokes acceleration of the heart, amplified respiration, and increased vaso-constriction. A sudden rise of tension, on the other hand, provokes a slow heart, shallow respiration, and vaso-dilatation.

This compensatory mechanism, as Leonard Hill † has pointed out, is under the control of the group of bulbar centres. In cases

* 'The great splanchnic area forms the resistance-box of the circulation; if it be contracted, the blood takes the pathway through the locomotor organs; if it be dilated, the blood passes into the capacious veins of the abdomen' (Leonard Hill).

† Schäfer, 'Text-book of Physiology,' vol. i., p. 95.

of shock, however, this power of control is partially, or entirely, abolished.

We may therefore regard shock after abdominal operation as due to irritation applied to splanchnic nerves, which causes not only a local paralysis of the nerves governing the calibre of the abdominal vessels, but by causing an exhaustion of the bulbar centres exhausts the compensatory mechanism which governs the circulation of the whole body, and the diminution of arterial tension becomes the most characteristic symptom of shock.

Symptoms of Shock.

The symptoms may come on either during the operation or immediately afterwards, or a day even may elapse, as in instances of late or deferred shock.

The symptoms of shock usually develop gradually as the operation proceeds, but at any time if a severe or rough measure is practised by the surgeon the patient may suddenly exhibit symptoms of profound shock, which are not to be confounded with asphyxia due to the anæsthetic. We can remember an instance when a well-known surgeon in London, whilst performing a section, suddenly dragged with great force on a very firm adhesion in Douglas's pouch; the patient immediately expired on the table.

As the operation proceeds and shock develops, the patient's pulse begins to grow smaller and faster, the lips become blanched, the skin gets pale, cold, and clammy, the pupils dilate, and the respirations become hurried and shallow.

When the operation is finished and the patient is placed in bed, she lies in an unconscious condition, quite motionless in whatever attitude she is placed; her face is pale, and covered with a clammy sweat; her features are pinched, and breath cold; her lips are colourless or blue; her eyes show no reflexes, the pupils being dilated and the lids half closed. Her skin is moist and clammy, her extremities cold and lifeless, while her temperature has fallen to normal or has become subnormal even though it was considerably raised before the operation.

Her pulse, taken at the wrist, is very characteristic. It is small, very quick (130),* and compressible; it is evident that the vessels at the wrist are only half filled.

* We have, on several occasions, noticed that after extensive operations on elderly people, where there has been but little loss of blood, the pulse-

The respirations are quick and shallow through a half-opened mouth, the breathing is thoracic, the abdomen scarcely moves, and as the reflexes are dulled the phlegm is churned up and down in the throat.

The patient may continue in this condition, quite unconscious of everything, for hours after the operation. Usually, however, she responds to stimulation; her cornea, if touched, shows the returning reflexes; she begins to vomit, and gradually becomes fully conscious. She then begins to complain of thirst, for her tongue is dry from deficient saliva, and her voice as she asks for a drink is husky. Her pulse becomes more perceptible at the wrist, and gains more volume; her skin begins to get warmer; her features lose their pinched look, and her respirations become slower and deeper. Her kidneys, which during the continuation of the shock secreted little or no urine, now begin to act again, and after some hours 3 or 4 ounces of urine will be found in the bladder, but she has no desire to micturate. The bowels have no inclination to act for themselves, though an injection thrown into the rectum may be retained only in part.

In general surgical practice we frequently find that when the reaction sets in after an operation in which there was considerable shock the face becomes flushed, the skin warm, the temperature shoots up, and the pulse increases even to 190—as we recently observed after performing an interscapulo-thoracic amputation on a boy—and the patient becomes delirious. This intense reaction is not common after cœliotomy; it does, however, occur at times in elderly women, especially in those addicted to drink, and the patients may at times become perfectly maniacal and endeavour to get out of bed. Their efforts, however, soon exhaust them, and they collapse suddenly.

In some cases—in elderly women with atheromatous arteries—we may have a high degree of shock present, yet the radial artery shows little or no alteration either in volume or frequency.

rate has been only slightly increased in rapidity. It would appear that in these cases the muscular coat of the arteries has become the seat of calcification, and consequently the muscular function tends to become obsolete, and with its loss of elasticity the muscular coat of the vessels is unable to be influenced to any great degree by the vasomotor nerves; consequently the peripheral circulation is not so grossly disturbed as in younger people. In such cases we are not to jump to the conclusion that there is an absence of shock because the pulse-rate is not increased.

In the first section case that we lost, the woman remained in a condition of profound shock for twelve hours after the operation, and then died, her pulse and temperature being quite normal the whole time.

Continued Shock.

In some instances when the operation has been a prolonged one, and the patient is debilitated, we find that she awakes from the anæsthetic, she becomes warm, and her appearance improves. Her respirations are not much quickened (22 to 25), but her pulse-rate does not fall below 120. She complains of thirst, and says that the binder is too tight. She often vomits continuously, and after each attack the pulse is quickened and she feels exhausted. If a saline transfusion is given, the pulse becomes fuller for a time, but a few hours later it becomes again very small and very rapid (150). The patient is calm and quiet, the face is pale and pinched, but the skin is warm though clammy. She does not respond to strychnine or nutrient enemata, and her abdomen becomes distended ; the bowels only act after repeated enemata. Neither digitalis nor digitalin, caffeine, ammonia, or adrenalin influence the pulse-rate to any extent ; it gets smaller and smaller, quicker and quicker, and the patient expires thirty-six hours after the operation. The autopsy shows no sign of peritonitis, a bacteriological examination shows an absence of septic germs ; the patient dies from what we are accustomed to call **continued shock.** The higher centres never recover from the effect made on them during the course of the operation, and there is a complete breakdown in the vasomotor mechanism. The compensatory mechanism which governs the circulation has been abolished by exhaustion or inhibition of the bulbar centres, and the consequent condition of the circulation is inadequate to maintain life.

Continued shock occurs most frequently after prolonged operations on anæmic women, when the anæmia is due to long-continued pain and misery or malignant disease, especially when any of these conditions are associated with organic disease of the heart, such as we encounter in women who have had large fibroids for years.

Late Shock.

Late shock, or deferred shock, may come on several hours after the operation, or even a whole day may elapse. As

Olshausen has pointed out, he operated on a case having a temperature of 35·4° C.; this rose after a few hours to 37·5° C., but fell on the ensuing day to 36·5° C., when her pulse rose to 130 and she became collapsed.

These cases would sometimes appear to be really instances of secondary hæmorrhage, but in Olshausen's case there was a vaginal drainage-tube, but no blood escaped.

In one of Kelly's cases the pulse on the second day was observed to go steadily upwards, ranging between 140 and 150 on the third day, when it was scarcely perceptible. The patient showed no blanching and was bright, and the pulse slowly came down, but did not get below 100 again until the twelfth day.

Diagnosis and Prognosis.

Diagnosis.—While the patient is still on the operating-table we shall have to differentiate between asphyxia (due to the anæsthetic) and shock.

After the operation we shall be called upon to decide whether the symptoms that the patient is exhibiting are due to continued shock, late shock, secondary hæmorrhage, septicæmia, or embolism. There are instances in which it has been impossible to make a definite diagnosis. Many section cases have been placed on the operating-table under the impression that there was septic trouble present, or secondary hæmorrhage, and the second operation—and frequently the autopsy that followed—demonstrated that the patient was suffering only from shock.

During the first twelve hours the diagnosis is not surrounded with many difficulties, because, no matter how virulent the sepsis may be, the patient does not exhibit any definite symptoms of poisoning until ten or fifteen hours have elapsed; while the oozing of blood from torn adhesions, unless it exceeds 4 ounces, will not give rise to alarming symptoms. The picture, however, becomes a confused one if we have some degree of shock to start with, combined with moderate hæmorrhage later on.

It is during the second and third day (eighteen to thirty-six hours) that we have at times the greatest difficulty in arriving at a definite conclusion, because it is during this period that we may have secondary hæmorrhage, continued shock, or septic complications, occurring alone or together.

The following case was an example of continued shock,

although it appeared at first sight to be one of secondary hæmorrhage.

We were asked by one of our colleagues to see a case from which the tubes had been removed for double pyosalpinx. The operation, at which we were present, occupied one hour and thirty minutes. The patient left the table with a pulse of 130, and this increased suddenly six hours after the operation to 150, and continued at that rate for twelve hours.

When seen eighteen hours after the operation, the patient was lying calmly in bed, the pulse being 160, small and thready. The patient's nostrils did not dilate; there was no air-hunger. She lay quietly and almost flat in bed, and she did not attempt to throw her arms about.

Her temperature had at first risen a few degrees, but when examined it was found to be normal.

The calmness of the patient convinced us that she was suffering from 'continued shock,' and, in spite of all remedies, she died in six hours, twenty-four hours from the time she was operated on. The autopsy showed that there had been no hæmorrhage; there was nothing to account for her death but shock. A bacterial examination of the pus in the tubes showed that it was sterile.

We insist on this point: a patient whose pulse is 150, and who can lie flat on her back in bed without a pillow at her head, may be suffering from profound shock, but is never suffering from secondary hæmorrhage to any serious extent.

Prognosis.—The pulse is one of the best guides to the condition of the patient, and by carefully studying its rate and volume we can estimate the progress that the patient is making. Even though the pulse may almost disappear at the wrist, there is no reason why the patient should not recover.

When we find that the pulse-rate continues very rapid (150) an hour after an injection of saline fluid under the breast, we must consider the patient's condition serious. When we find, however, that after the injection of saline the pulse grows distinctly slower and increases in volume, and with this change in pulse the patient becomes rapidly conscious and the feet become warm, and the temperature does not fall below normal, but has a tendency to rise, then the outlook is much more favourable.

When we find that the pulse-rate is 140 to 150 eighteen hours

after a section, in spite of the fact that there are no symptoms of secondary hæmorrhage, we must consider the patient's condition very grave, for we are probably face to face with a condition of 'continued shock.' However, it is always well to remember that a pulse may vary between 130 to 150 for some days after an operation, and still the patient may make a good recovery.

One condition makes slight shock a grave complication, and that is continued oozing. Zweifel and Smyly have dwelt on this point. The latter says:

'But if, on the other hand, even a small hæmorrhage goes on, it works against the heart's action both dynamically and reflexly. When the latter improves, the hæmorrhage increases; as more serum flows into the circulation, the blood becomes more watery and less coagulable, and thus less adapted to the spontaneous closure of bleeding vessels. The heart working with a half-filled circulation, aggravated by even a small continued loss, he (Zweifel) likens to a steam-engine working a ship's propeller which lifts out of the water, or a locomotive where the wheels slip upon the rails. The mechanism is imperfect, having lost its accustomed grip; it resembles a pump insufficiently supplied with water. It is, in fact, an empty pumping heart, which authors term "shock."'

Treatment.

There are few complications in surgery to which the adage, 'Prevention is better than cure,' can be applied more appropriately than to shock. Treatment should, therefore, be considered under the following headings:

1. Prophylaxis.
2. Treatment of threatened shock.
3. Treatment of shock when established.

1. **Prophylaxis** will concern itself with such matters as—(*a*) The preparation of the patient; (*b*) the care of the patient on the operating-table; (*c*) position of the patient on the operating-table; (*d*) rapidity in operating; (*e*) prevention of hæmorrhage; (*f*) selection of the anæsthetic.

(*a*) Preparation of the Patient.—In preparing our patient for a section, we must by a thorough examination endeavour to find out if there is a secondary pathological condition, apart

from the one that we are called upon to deal with, that is likely to influence the patient during the operation.

Recently we were called upon to operate in a case of twisted ovarian cyst. The operation was simple, but the patient was thin and anæmic, and suffered from continued shock after the operation. Her condition was also made worse by hæmatemesis. She expired thirty-six hours after the operation, and the autopsy showed that she had advanced carcinoma of the stomach. The case illustrates well the maxim that patients debilitated by malignant disease bear shock badly and recuperate slowly.

We should pay especial attention to those patients who are much weakened by continued hæmorrhages, and in all such cases we should make one or more blood examinations before the operation, because, 'on account of the hæmolysis, which is shown by the fall in corpuscular hæmoglobin after operation, a very low percentage of hæmoglobin must be regarded as a contra-indication to the administration of a general anæsthetic.'*

Mickulicz sets 30 per cent. as the lowest percentage at which an operation may be attempted; others think that 40 per cent. should be the lowest limit.

A careful study of each patient before an operation will enable us better to gauge the 'personal equation' in each case.

We lay the greatest stress on the preparation of elderly women who have been accustomed to drink spirits. In such cases the heart is seldom sound, and while a normal heart has little to do with the rapid pulse of shock, yet such cases as those in question go through a prolonged operation with much happier results, provided that they are treated with digitalis and acetate of potash for some weeks before.

Another class of cases must receive every care beforehand. They are young women who have lived in poverty without a comfort, and who are thin and anæmic. These patients may have lost little blood, but if they are operated on soon after being admitted into hospital, their pulse remains at 130 for hours, and sometimes for days, after a section, and, if they pull through, it is often more by 'luck' than anything else. These patients have a deficient supply of hæmoglobin; the anæsthetic appears to extract oxygen from oxyhæmoglobin, and the corpuscles being deprived of oxygen that they cannot spare, the patient often collapses on the table, and remains in a state of

* Da Costa and Kalteyer, *Annals of Surgery*, September, 1901.

shock for hours after being placed in bed. These patients do not revive when saline solution is injected; it even appears at times to make their condition worse, probably because of the free carbonic acid dissolved in the saline, and this influences the respiration and heart.

When dealing with nervous or hysterical women, we should see that on the night preceding the operation they are not allowed to lie awake; we should administer a dose of trional or sulphonal, and by commencing the operation early in the day we avoid that long wait which must be a sore trial to the bravest. It is more than probable that the nervous state into which some timid women work themselves is often a large factor in producing shock. These patients should always be given a hypodermic of morphine ($\frac{1}{8}$ grain) half an hour before the operation.

But while the nervous woman receives our attention, we must not forget that the strong and muscular suddenly put to bed and operated on suffer often more shock than the chronic invalid.

Lastly, very young patients, and women who are advanced in years, are predisposed to shock, the one because the nerve tissues work so well that the impulses are quickly conveyed, strongly reflected, and soon exhausted; the other because her powers are so feeble that exhaustion soon follows when her tissues are called upon to battle against excessive irritation. But it is a great error to suppose that the aged, provided that they are strong and vigorous, cannot stand prolonged operations. We have performed sections on patients over seventy years of age whose pulse, after such operations as excision of a large portion of the stomach or of the cæcum, was quite normal, and remained so for days after. Sir George Humphrey long ago combated the idea that the aged were necessarily bad subjects for a big operation.*

Keeping a patient for twelve hours or more without food before the operation commences is an utter mistake; the administration of some easily-digested food is both logical and wise. We know of nothing so well adapted for patients as Carnrick's liquid peptonoids, a couple of ounces being given in soda-water. It is easily assimilated, and it is stimulating, on account of the alcohol that it contains.

* *British Medical Journal*, July 12, 1884.

There is another point in connection with the preparation of the patient that may have some important influence on shock. The hot baths, the purging by means of saline carthartics, and the withholding of liquid previous to the operation, all tend to produce a temporary apoplasia; the volume of plasma is for the time reduced, and there is a proportionate rise in corpuscles. Mr. Sherrington has shown that after opening the abdomen of dogs a well-marked increase in the density of the blood occurred, and according to Cobbett, Grünbaum has observed that in instances in human beings in which laparotomy was performed the specific gravity of the blood rose during the course of the operation.

Sherrington* further showed, as an accompaniment of the increase of specific gravity of the blood, that symptoms developed closely resembling the symptoms of shock, even to the congestion of the mesentery. It is not improbable, therefore, as Cobbett† has remarked, that this deprivation of fluid previous to the operation, if carried too far, 'may be a distinct disadvantage, and cause the reserve of fluid in the tissues to be materially diminished at a time when it is to be called upon for the purpose of maintaining the density of the blood at its normal level. There can be no doubt, then, that after a severe abdominal operation the blood may lose much of its fluid and become thickened, as it does during an attack of cholera. It is unreasonable to attribute to this cause the symptoms of collapse which often follow such operations.'

Many surgeons place great reliance on the preliminary injection of certain drugs, holding that they are capable of preventing shock.

The two drugs most frequently employed are atropine and morphine.

It is maintained by some that the use of atropine in shock is a 'triumph of experimental therapeutics, and rests upon logical deduction' (Hare) and that atropine in the first stage of shock acts as a depressant to the vagus nerve, and as this nerve is overactive in the first stage, the drug acts as a sedative to it. In the second stage it acts on the vasomotor system, and by 'preventing the dilatation of the bloodvessels of the body thereby provides blood-paths of normal tone and tenseness, which do not

* Sherrington and Copeman, *Journal of Physiology*, vol. xiv., p. 84.

† Allbutt, 'System of Medicine,' vol. iii., p. 329.

hold all the blood in stagnant pools where it is not needed, but carry it to the brain and vital parts.'*

We have for a long time at the Lewisham Hospital been accustomed to inject atropine and morphine before performing a section, and we are satisfied that these drugs exert a favourable influence and help to diminish shock.

Crile's experiments with atropine showed that the drug was an efficient protection against cardiac inhibition in operations on the 'inhibition area,' in the larynx, and in such operations that might cause mechanical stimulation of the vagi. Ten observations on preliminary injection of atropine to prevent splanchnic shock left him in doubt as to its efficiency, but on the whole the evidence would seem to show that shock was diminished.

He found that in a series of experiments on cocaine administered to prevent splanchnic shock there was very strong evidence of its efficiency. This is a most important fact, and this may, perhaps, be used in the future with good results in preventing shock, for nerve tracts may be physiologically 'blocked' by cocaine, so that neither efferent or afferent impulses of any kind can pass; hence, as Crile points out, the area so protected cannot, during any operation or injury, be the starting-spot for the slightest degree of shock.

Many experienced operators inject brandy into the bowel before the operation begins. Christopher Heath † says that for years he has been accustomed to inject into the rectum, with a long tube, 2 ounces of brandy with 4 of hot water. This, he says, 'acts as a reserve of power which can be absorbed at leisure, and has the advantage over the administration of a stimulant by the mouth that it cannot embarrass the breathing.'

We are opposed to the administration of brandy by the mouth before an operation—firstly, because strychnine is a much better stimulant; and, secondly, because, as Silk ‡ remarks, 'physiologically or clinically considered, the use of brandy by the mouth is irrational, as it encourages the tendency to retching and vomiting, and increases the poisonous effects of the anæsthetic.'

If the patient is in a weak condition, a hypodermic injection of strychnine ($\frac{1}{20}$ grain) may be given with advantage, and on account of the rapid and excellent effect of suprarenal capsule

* Hare, 'Practical Therapeutics,' eighth edition, p. 689.

† *British Medical Journal*, vol. ii., 1889, p. 234.

‡ Cheyne and Burghard, 'Manual of Surgical Treatment,' vol. i., p. 83.

on the heart and blood-pressure 10 grains of this substance may also be administered with good effect, or we may give adrenalin (5 minims) under the skin. If the suprarenal capsule is not to be procured, ½ drachm of Tr. digitalis should be given an hour before the operation, for this drug has, as Wood pointed out, a peculiar steadying or sustaining power, combating the circulatory depression naturally produced by the anæsthetic.

(*b*) Care of the Patient on the Operating-Table.—We have already described the manner in which the patient should be clothed during an operation, and have dwelt on the great importance of keeping her warm either by a specially heated table, or by surrounding her with long sand-bag-shaped hot-water bottles. The chest is to be covered with cotton-wool, and in some cases we have had a pair of pantaloons constructed out of cotton-wool surrounded by gauze when we anticipate much shock. The temperature of the room should not be below 65° F., and we find 72° F. an excellent temperature for winter weather. Many surgeons, however, prefer a much higher temperature.

(*c*) Position of the Patient on the Operating-Table.—The employment of the Trendelenburg position assists us in lessening shock, because we are able to get the intestines well away from the field of operation, and we can then wall them off well with gauze sponges, and by these means we prevent cooling and diminish irritation, and so prevent a rapid dilatation of the splanchnic vessels.

If the omentum is well developed, it is a good plan before placing in the gauze sponges to draw it well down, so as to act as a curtain between the intestines and the sponges, because the omentum is not nearly so sensitive as the intestines, and even prolonged manipulation of it will only cause slight dilatation of its vessels.

(*d*) Rapidity in Operating.—Time is an element of such vast importance that we have come to regard it as perhaps the most important element in the development of shock, and we cannot doubt that many of the successes of well-known surgeons can be attributed quite as readily to the rapidity with which they are able to operate as to their superior technique. The time element grows in importance as we advance from the pelvis towards the stomach, because we are progressing from organs, such as the bladder and uterus, where manipulation for considerable periods

is not attended by marked disturbances in the circulation, to organs whose exposure for even a short time results in a marked change in the splanchnic circulation.

The time element, again, is of vast importance in cases where we are dealing with acute conditions, such as ileus, where every moment is of importance. Consequently, in such cases the skin should be prepared before the patient is given the anæsthetic.

But while we advise rapidity, we do not advise haste, and if, in our endeavours to be rapid, we use force and tear or drag on the tissues, we shall help to create shock. We are convinced that great tension on any tissue during the course of an operation is one of the most certain methods of causing profound shock, and we shall never forget the lesson which we once learnt whilst watching a well-known surgeon in London, who, during a difficult enucleation of an adherent cyst, suddenly put a great strain on some adhesions in Douglas's pouch, and the patient immediately expired.

Time is also of importance when one comes to consider the anæsthetic, and there can be little doubt that the longer the anæsthetic is administered the less is the organism able to resist the development of shock, and this is especially applicable to chloroform, because it is more toxic than ether.

(*e*) Hæmorrhage.—Preventing a loss of blood may be of the very greatest importance in preventing shock, for a loss of blood always predisposes to shock; and whereas a loss of $\frac{1}{2}$ pint may be of little importance in some cases, the conservation of almost every drop may be a vital necessity in debilitated women.

Young surgeons often think that loss of blood from veins is of little importance; but in cases where there already exists some degree of shock, the loss of blood from large venous trunks, such as we encounter in dealing with fibroids of the uterus, will often have the most profound effect on the patient's condition, because the blood-pressure is immediately affected as less blood enters the right side of the heart.

Loss of blood also increases shock by interfering with respiration, and so depriving the blood of some of its oxygen.

We operated on one occasion on a woman because she had had considerable hæmorrhage, which we believed was due to a large cystic ovary. The ovary was removed, the operation lasting nine minutes, and the patient had no shock. Five weeks elapsed, during which time the metrorrhagia continued until the

patient was exsanguinated. To save her life we again opened the abdomen, and removed the remaining ovary and tube, the operation taking fifteen minutes. The patient suffered from profound shock, and lay unconscious for hours after the operation. She then improved in health, and the hæmorrhage ceased. A year later we operated on one of her kidneys; the operation took an hour, but she showed no signs of shock whatever.

(*f*) Selection of the Anæsthetic.—There appears to be more liability for the patient to develop shock when chloroform is used than when ether is employed.

Dudley Buxton says that the shock of operation is, to a great extent, caused or enhanced by the physiological action of chloroform, and this is most marked in anæmic persons and in those who have lost much blood during the operation. The explanation of the action of chloroform under these conditions is to be found in the alteration of pressure of the abdominal contents after the abdomen had been opened. For the maintenance of intra-abdominal pressure the action of the recti and of the diaphragm was needed, and during cœliotomy this action could not be exerted. When, in addition, the action of the nerve centres is weakened by anæmia, the effect of chloroform in lowering blood-pressure through the filling of the 'abdominal pool' is greatly enhanced. Consequently, the mere opening of the abdomen made the patient more liable to shock from chloroform than was the case in any other kind of operation.*

Leonard Hill has shown that chloroform has the power to abolish the 'compensatory mechanism' which regulates the circulation.†

2. **Treatment of Threatened Shock.**—One of the advantages of employing an experienced anæsthetist is that he will quickly recognise symptoms of threatened shock, and warn the surgeon.‡

If the operation has lasted for a considerable period, and the anæsthetic employed be chloroform, we should at once discontinue its use and employ ether, because chloroform depresses all

* *British Gynæcological Journal*, vol. xv., p. 83.

† *British Medical Journal*, London, 1897, vol. i., p. 957.

‡ 'A blood-pressure' apparatus is used by some surgeons during the operation, and this gives valuable information of the alteration in arterial tension (Cushing, *Annals of Surgery*, September, 1902).

vital functions, and produces an effect on the circulation very similar to that produced by shock.

Ether does not produce this vasomotor paralysis, and consequently we shall find that the change from chloroform to ether has often a very good effect on the condition of the patient.

We must always bear in mind that in choosing a remedy to counteract the effect of the shock we are not employing one that will increase the toxic effect of the anæsthetic.

Strychnine.—If it becomes manifest towards the conclusion of an operation that the patient is suffering from shock, the surgeon should immediately order a hypodermic injection of strychnine. This drug is now universally employed, and it gives most excellent results. It is the one drug that is of use in shock, and it has the further advantage of being of great use if the anæsthetic is contributing to the depressed condition, because it affects the respiration to such good purpose.

We must not, however, fall into the error of giving this drug in too large quantities. It is true that we may get but a faint reaction after the injection of $\frac{1}{10}$ grain, and this is often taken as a sign that the quantity is to be increased. But it must not be forgotten that during the period of profound shock neither strychnine, nor any other drug, may visibly manifest its work, but on the shock passing off toxic symptoms may develop from the overdosing of the patient. We therefore do not advise more than $\frac{1}{10}$ grain of strychnine to be injected at first, and this may be followed, if necessary, in fifteen minutes by $\frac{1}{20}$ grain. After two hours $\frac{1}{20}$ grain may be given, and this may be repeated every four hours.*

* It is interesting to note the quantity of strychnine that may be given at times. We were once called to a patient, a strong man, who had taken 2 ounces of laudanum. We injected atropine and strychnine, and continued to inject under the mistaken idea that we would get an immediate effect. We injected in all $\frac{1}{2}$ grain of atropine and $\frac{1}{3}$ grain of strychnine. The patient recovered, but showed signs of strychnine poisoning.

We have seen strychnine convulsion after injecting $\frac{1}{6}$ grain of strychnine. The patient had chronic nephritis, and the operation of removing her tubes and ovaries had been a severe one.

Whiteford[1] records a case where, during the course of an operation, he administered 50 minims of liquor strychnine 'without producing the slightest twitching.' In another case he gave 1,865 minims of the liquor in sixty-four

[1] *Lancet*, April 12, 1902.

It is of great importance that strychnine should be given at the very beginning of shock, or even before, so that it may be able to act before the shock is well established.

Ether.—Since ether is one of the most diffusible and rapidly-acting stimulants when injected hypodermically, it is often employed in commencing shock. Its use is indicated in cases where the heart is weak. Its action, however, is fleeting; it can have little, if any, effect on the vasomotor palsy that is commencing. Its use is contra-indicated if we have been employing ether as an anæsthetic, 'for ether in the blood acts as ether, whether it finds entrance through the lungs, through the rectum, or through the cellular tissue' (Wood). The same objection does not hold good if we have employed chloroform.

Alcohol.—It is a usual thing to administer alcohol by the bowel when the patient is on the table; we frequently pour a few ounces into the saline fluid that is being injected under the breast. We have begun lately to consider seriously whether alcohol really does do any good. If we give alcohol before we administer chloroform it requires less chloroform to anæsthetize; in other words, alcohol intensifies the influence of chloroform, and many experiments have shown that alcohol, if given after

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days without any symptoms of poisoning, and in another 65 minims in sixty minutes.

Moynihan[1] records that in a case of double primary amputation 45 minims of liquor strychnine were given hypodermically in three-quarters of an hour, with no symptoms of poisoning.

Mayo Robson[2] gives 10 minims before the operation, and '5 minims of solution of strychnine are given subcutaneously every two hours for several hours if called for' after the operation for obstructed bile-duct.

Hall,[3] commenting on Whiteford's cases, stated that he was in the habit of injecting 10 to 15 minims as a first dose, and then gave 10 minims hypodermically whenever the pulse showed signs of failing. I have, he says, given 40 minims during an operation in this manner in a case of extreme collapse.

Green,[4] commenting on these large injections, recorded a case where a boy, aged six years, was given 5 minims of strychnine before an operation for perforation of the pylorus by a foreign body. During the operation the patient's condition became extremely critical, and a second injection of 5 minims of strychnine was given. In three hours' time the boy was seized with convulsions, and rapidly passed into a condition of opisthotonos, and died before chloroform could be administered.

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[1] *Lancet*, December 14, 1901. [2] *Ibid.*, April 12, 1902.
[3] *Ibid.*, May 10, 1902. [4] *Ibid.*, May 10, 1902.

chloroform, greatly increases the rapidity of the fall of the arterial pressure, and helps to extinguish the pulse. If, on the other hand, ether has been employed as the anæsthetic, then the administration of alcohol is useless, because alcohol is so nearly allied to ether, both physiologically and chemically, that the only result it can have is to increase the toxic effects of the ether.

All things being considered, we think that alcohol should be sparingly employed, and if we mix it with the saline, or inject it into the bowel, then about 2 ounces may be employed; but this is not to be repeated for some hours, until the stage of reaction sets in.

Ammonia.—Instead of employing alcohol alone, it is a much better plan to inject into the bowel carbonate of ammonia, and with this give the 2 ounces of alcohol mentioned above. The enema recommended by Howard Kelly is certainly an excellent one. It consists of 20 grains of carbonate of ammonia, 2 ounces of brandy, with sufficient water or beef-tea, at a temperature of 100° F., to make an 8-ounce enema.

We think that the enema that we employ at the Lewisham Hospital has certain advantages. For the brandy and beef-tea we substitute Carnrick's liquid peptonoids, and add to this carbonate of ammonia and tepid water. Beef-tea at any time has not much nutrient value; a large portion of it is not absorbed by the bowel in health, and probably much less is absorbed during shock, whereas Carnrick's peptonoids are readily absorbed and have a high nutritive value.

If we inject ammonia hypodermically, we should inject only a few minims of the liquor ammonia fort into a vein of the leg, so that it will not reach the heart in a too concentrated form. It should never be injected into the tissues, otherwise a slough will be the result.

Adrenalin.—In all cases where shock is commencing, it is our practice to administer adrenalin (5 minims) hypodermically, and when the patient is placed in bed we augment the action of this drug by administering the tincture of digitalis ($\frac{1}{2}$ to 1 drachm) by injection under the skin, or under the breast in the saline. The great advantage that the adrenalin has over the digitalis is the rapidity of its action; the one acts in a few seconds, the other takes an hour or more to produce its effect.

While the patient is still on the table, then, we employ strychnine and adrenalin hypodermically, and ammonia by the bowel

and, if necessary, begin the injection of normal saline with brandy. The coverings on the patient are carefully attended to, hot-water bottles are placed about the limbs, all damp towels removed, the chest is kept well protected by cotton-wool, and before the patient leaves the operating theatre artificial respiration is practised for a short period. This may be done by the anæsthetist while the surgeon is arranging the dressings. The artificial respiration acts beneficially by helping to eliminate the anæsthetic, and by supplying the blood with oxygen, for 'the blood in shock is insufficiently supplied with oxygen. An increased supply of oxygen is urgently demanded' (Crile). Inhalations of oxygen can be given with great benefit.

Hypodermoclysis is indicated in all cases of shock where there has been much loss of blood before or during the operation. It is also called for when the patient has not suffered from hæmorrhage, but the circulation is feeble and the pulse becomes very small and compressible during the course of the operation. In these cases the features become pinched and the skin cold, and the bloodvessels are incompletely filled.

To inject saline solution in simple or uncomplicated shock, when the patient at the beginning of the operation had a good pulse and looked strong and vigorous, will do no good, and probably will do harm by adding to the already embarrassed circulation.

In cases where there has been much hæmorrhage, the subcutaneous or intravenous injection of from 40 to 80 ounces of saline solution is usually followed by a rapid improvement in the patient's condition and a lessening of the symptoms of shock.

The value of these saline injections in shock are chiefly mechanical: the vessels contain more fluid, the blood-pressure rises, the output of the heart is increased, and its beat becomes slower, fuller, and stronger.

At one time the saline solution was always introduced by direct infusion into a vein. This is now seldom employed, because the submammary infusion is so simple and efficient that it may be carried out by a nurse or by the anæsthetist while the surgeon proceeds with the operation. The mere fact that it is introduced slowly into the circulation is a great advantage, for there is a danger that, if the saline be rapidly infused into the veins, the patient may develop alarming symptoms,

'for the fluid that is driven from the heart into the lungs may consist of pure salt solution, and consequently signs of imperfect aeration of the blood at once become evident, the respiration becomes embarrassed, and twitchings and restless movements occur, and the patient may die at once. If any symptoms of this kind occur, the tube should at once be clamped so as to arrest the flow of the saline solution till the dangerous symptoms have passed off.'*

If the patient be a young woman with small breasts and little adipose tissue about the chest, 20 ounces will be ample for each breast; and even this amount, if the patient becomes conscious before the fluid is absorbed, will cause her to complain of the great pain from the increased tension.

Women who have lax tissues and an abundance of adipose tissue can take a quart of the saline fluid under each breast without inconvenience.

Twenty to thirty minutes is about the proper length of time to take to inject 2 pints under a single breast, and as the fluid —at first at a temperature of 100° F.—will become cooled during this space of time, the rubber pipe should be coiled round in a basin of boiling water, and this may be renewed from time to time.

If we have two trocars, we may insert one under each breast, and so distribute the fluid, which may flow from one or two reservoirs.

Before inserting the trocar the skin should be washed with a little peroxide of hydrogen. The anæsthetist should seize the breast and pull it well up, and the trocar is then plunged into the loose cellular tissue beneath the breast. Care should be taken not to pierce the breast itself, as the fluid will not run out well and the patient will suffer great pain when conscious.

Instead of running the trocar under the breast, we frequently run it down by the edge of the pectoral muscles, so that the fluid will transfuse into the loose tissue of the axilla.

If the fluid does not run freely, the trocar should be withdrawn for an inch or so, and if the fluid still refuses to run, it is better to plunge the trocar in a different direction, without, however, withdrawing it through the perforation in the skin.

On withdrawing the trocar at the conclusion of the transfusion

* Cheyne and Burghard, *loc. cit.*, vol. i., p. 138.

some adhesive plaster must be placed over the skin puncture, else the fluid will be slowly forced out and will run down and soak the patient's bedclothes. For some days after the patient will complain of the breasts being very tender, but we have seldom seen any local trouble follow.

The quantity of fluid to be injected will vary with the gravity of the case, but it appears to us that 3 pints of saline is quite sufficient to commence with even in serious cases, and we can augment this by leaving a pint or more of saline in the peritoneal cavity, and an hour or two later we can give a pint by the bowel. By introducing saline into blood in this gradual manner it becomes slowly mixed with the blood, and the nerve centres are not bathed suddenly by greatly diluted blood, which would only have the effect of making their already feeble action more feeble by the circulating fluid not only being deficient in oxygen, but the introduced fluid adds a considerable amount of carbonic acid to the blood.*

3. **Treatment of Shock when Established.**—The operation is completed with rapidity, and no time should be wasted in closing the abdominal wound with layers of sutures; through and through sutures of silkworm gut, inserted by means of a handled needle, should be employed.

A tight abdominal binder is then applied.†

The patient should be removed to bed without delay, and if her room is at a distance from the operating theatre, she should

* Schucking points out that the task of eliminating the CO_2 under normal circumstances is allotted to the paraglobulin, the alkaline compound of the blood, and he believes that saccharate of soda might take its place, inasmuch as this compound is split up by CO_2 into sugar and sodium carbonate, so fixing the CO_2. He employs the saccharate in the form of 0·03 per cent. subcutaneous injections, with 0·6 per cent. of salt; and he is satisfied with the efficient action of the injection.

Ringer investigated the influence of carbonic acid dissolved in saline solutions on the ventricle of the frog's heart, and found that free carbonic acid dissolved in saline arrests cardiac contractibility, while saline made of boiled distilled water, from which, therefore, most of the carbonic acid is expelled, permits the ventricle to contract longer than saline made of unboiled distilled water. Oxygen dissolved in saline apparently exercises no influence in sustaining or impairing cardiac contractibility.—*Journal of Physiology*, 1893.

† Compression of the abdominal walls causes the capacity of the veins and splanchnic area to be reduced; the right heart is thus helped to be filled, and so the arterial pressure is raised.

be rolled in a warm blanket, and a large hot-water bag may be placed under her.

The bed should have been warmed by several hot-water bags; if the weather be cold a fire should have been placed in the room, so that the thermometer will register between 75° to 80° F.

If the nightdress of the patient has become damp or soiled during the operation, it must be removed before the patient is placed in bed, but it is not necessary to put on another, and when the patient is placed in bed a warm blanket is placed next her skin.

The long sand-bag-shaped rubber bags are fixed along her sides, between her legs, and at her feet, but more care than usual is to be exercised to see that each bag is covered with *two* or *three* layers of thick blanket, for the patient's vitality is so low that even a moderate heat will burn her severely.

The patient's head must be kept low, and the foot of the bed raised on blocks. This is most important, and should not be neglected, especially if the patient has been kept in the Trendelenburg position during the operation. This position facilitates the return of the blood, and the quantity supplied to the brain and heart is increased and the blood-pressure is raised.

If, however, the patient's face is cyanotic, as we sometimes find when there is respiratory failure after prolonged administration of ether, the bed should not be raised until the patient's face improves in colour.

If no saline solution has been given while the patient was on the table it may be given now, either in the form of a rectal injection or as an infusion beneath the breasts.

It is now also that ammonia and brandy are given by the bowels, if these have not already been administered.

Fowler recommends 1 ounce of whisky, from 3 to 6 grains of musk, and 15 to 20 drops of tincture of opium, added to a cup of strong coffee.

Robb, who has performed a series of 114 sections without a death, states that in every case the patient is given by the rectum 2 ounces of black coffee in two doses an hour apart, and besides this strychnine is also injected, and $\frac{1}{75}$ grain of sulphate of atropine is given twice.

Some surgeons always give atropine and morphine at this time, and in very young children or in old people we think it is

a wise plan, for when these patients awake and feel themselves in pain, the shock is increased. In cases where the shock is very marked morphine should not be given until the patient is fully awake, else it is apt to cause a great deal of depression.

After the patient has been in bed an hour, we generally see a favourable reaction. The skin becomes warm and moist, the pinched look about the face disappears, and the pulse becomes fuller and slower.

It is at this time that we believe that alcohol may be used with some benefit, for once the reaction has set in our object is to keep as much blood as possible out of the abdominal veins, and by administering alcohol now we are able to flush the skin and so help to redistribute the blood. Alcohol, therefore, may be injected subcutaneously (30 minims) from time to time, or an ounce or two may be given by the bowel. Champagne may also be given by the bowel. This was a favourite remedy with Mr. Tait, who frequently injected ½ pint soon after the operation.

If instead of a favourable reaction the patient's pulse grows quicker and smaller, we are powerless to alter her condition, for we yet want drugs that are capable of acting on the splanchnic area. The only drug that we possess that seems to have some influence on these dilated vessels is strychnine. This drug, however, by itself does not slow the heart; it rather tends to accelerate it, and cause the beats to become short. When, however, it is used in conjunction with adrenalin and saline solution, the beat becomes slower and fuller, unless the shock is very profound. We must not, however, fall into the error of supposing that because the pulse is increasing in rapidity we must give increased injections of saline solution. We are sure that we have seen cases where the saline actually seemed to hasten the patient's death. Saline can do no good when the shock is extreme, because vasomotor resistance is lost. When the shock is not too great, then the saline is capable of raising for a period the blood-pressure to the normal, but no higher.

Frequently the patient gets over the immediate shock of the operation, and her pulse-rate falls, and her temperature rises a degree or more; then twelve or eighteen hours later we find that the pulse is increasing again, until it reaches 140 or 150. The patient does not look at first collapsed, but the pulse-rate alarms us. This condition is what we have described as 'con-

tinued shock,' and it is certainly one of the most difficult conditions to treat in connection with the after-treatment of section cases.

The administration of a quart of saline solution subcutaneously may always be tried, and frequently works well, and we have got good results from injection of strychnine ($\frac{1}{20}$ grain), tincture of digitalis (30 minims), and adrenalin (6 minims). Nutrient enemata of peptonized milk and eggs, or Carnrick's peptonoids with port wine and quinine, should be given every four hours, while the patient's thirst is relieved by Vichy water and milk if the vomiting is not severe. Too much fluid should not be given by the mouth, as absorption is in abeyance.

Similar remedies should be employed in cases of 'late shock.'

CHAPTER XXXV

INTERMEDIARY AND SECONDARY HÆMORRHAGE

SECONDARY hæmorrhage was a complication that accounted for a very large percentage of deaths in the early days of ovariotomy. Peaslee showed that in 234 fatal cases of ovariotomy there were thirty-three deaths from hæmorrhage.

Improved technique made this complication more rare; nevertheless, from the numerous cases that speakers cite as their individual experiences whenever this subject is brought up for discussion, we must suppose that intermediary and secondary hæmorrhages are still complications of frequent occurrence.

Causes.

The most frequent cause of serious hæmorrhage after a section is the slipping of the ligatures from a pedicle. This will happen if the ligature has not been tied sufficiently tight in the first instance, or, if tight, the distal portions of the tissues have been severed too close to the ligature.

If in tying the ligature the assistant makes too much traction on the body to be removed, the elastic walls of the arteries will be stretched, and in severing the tissues the vessels will endeavour to retreat to the proximal side of the ligature.

The pedicle that is most likely to slip through the ligature is not the long thin one that can easily be encircled and compressed, and then relaxed when the ligature is tightened, but the broad sessile one, which is only tied by putting a considerable tension on the surrounding tissues, and which can be easily dislocated when traction is made on the uterus while the opposite broad ligament is being manipulated. Then when the patient is placed back in bed after the operation, and she begins to strain whilst vomiting, the tissues retreat still more, until at last they become free and hæmorrhage commences.

Harrison Cripps* reports a case where, after performing hysterectomy, he was summoned in the night, and found the patient with signs of bleeding. On reopening the wound, large masses of blood-clot and a quantity of fluid blood were found in the abdomen. The blood had come from a large vein that had slipped out of one of the ligatures on the broad ligament. Its open mouth, owing to its having retracted, was found with difficulty and was retied, but the patient died.

The nature of the tissues composing the pedicle is of no importance; thus, myomatous tissue is so hard that it can be compressed so as to give hæmostasis only after considerable force has been used, but being friable it will not allow us to use much force, and after the application of the ligatures the tissue shrinks, and allows them to become loose. For this reason secondary hæmorrhage from the thick pedicle of a pedunculated tumour has often occurred, 'as the contractile power of a pedicle of this kind, made up as it is of plain muscular fibres, is extraordinary' (Doran).

After Cæsarean sections, and after enucleating small fibroid tumours, hæmorrhage frequently occurs from the shrinking of the tissues and relaxation of the ligatures a few hours, or a few days, after the operation. Leopold reports a case where he had considerable hæmorrhage into the peritoneal cavity on the fifth day after a Cæsarean section, and this was followed by peritonitis and death. The autopsy showed that the wound had gaped.

In some cases where we are dealing with a tubal mole, or with pus-tubes, the tissues are soft and vascular, and ligatures, if tied tightly, cut through the inflamed and friable tissues very easily; while if only moderate force is exerted in tying the ligatures no hæmorrhage may occur at the time; but after some hours the tissues shrink, the ligature does not slip, but becomes loosened, and oozing occurs. In one of our cases where the tubes were filled with pus and the broad ligaments were œdematous, oozing occurred, and 2 pints of blood were sucked out of the glass tube in eight days; the patient recovered, and gained 70 pounds weight in six months.

In some cases the vessels have degenerated, and will not hold a ligature well. Recently in removing a fibroid tumour for long-continued hæmorrhage we noticed that the silk ligature cut through the uterine arteries whenever we used the slightest force;

* 'Ovariotomy and Abdominal Surgery,' London, 1898.

we were compelled to tie the arteries with catgut. On examining pieces of the arteries after removing the tumour, we found them very atheromatous.

The ligature itself may at times be at fault. In one of Howard Kelly's cases death occurred on the eighth day. 'The autopsy showed that there was a tremendous hæmorrhage from the uterine artery from the absorption and rupture of the catgut ligature, which allowed the organizing thrombus to be pushed out of the short stump of the artery.'

Hæmorrhage, as Doran has pointed out, may follow splitting of the pedicle. This accident, he says, is generally caused by neglecting to cross the threads, so that the two halves of the pedicle are pulled asunder as each loop of the ligature is tied.

We may get fatal hæmorrhage from adhesions that have been torn through during the course of the operation. Clay lost a case from hæmorrhage from the surface whence adhesions had been detached. In one of Bryant's early cases the patient died twenty-three hours after the operation. 'After death the wound was opened, and about 1 pint of blood was found in the pelvis. The ligatures on the pedicle were quite firm, and it was probable that the hæmorrhage had therefore come from one of the vessels in the false membrane which covered the cyst.'

In some cases the hæmorrhage comes from a vessel quite out of the field of the operation. Thus Reed, of Cincinnati, recently reported a case where, after removing large distended pus-tubes, the patient was placed in bed, but soon showed signs of hæmorrhage. 'I opened the wound, found the pedicle perfectly satisfactory, but in the careful enucleation I wounded a branch of the mesenteric artery away up under the meso-colon which had eluded my attention at the time of the operation.'

Hæmorrhage is especially liable to be serious in cases where some of the large veins of the omentum have been torn and overlooked, or where they have slipped from the ligatures. In a case operated on by Lockwood for hernia, the ligature slipped off the omental stump, and the patient bled to death; while in another case that he mentions the mere pulling on the omentum during the time of the operation led to a vein being torn through, and the patient died of hæmorrhage.

These cases show that venous hæmorrhage may be quite as serious as arterial hæmorrhage after an abdominal section, and many cases could be cited to further illustrate the point.

Thus Peaslee lost a case four hours after a section, and 'the post-mortem showed that the blood came from a rupture in a venous flexure beyond the outer ligature, which must have been produced by mere traction upon it while tying the knot, though a careful examination just before closing the incision detected no bleeding.'

After removing a broad ligament cyst there is sometimes a very considerable oozing into the space left; this, however, is seldom alarming.

Secondary hæmorrhage of a most alarming character may occur when the placenta is left behind after operating on cases of advanced extra-uterine pregnancy.

Cases have been reported where the hæmorrhage has occurred from the edges of the abdominal incision. Baylis lost a patient twenty-four hours after a section from hæmorrhage from the abdominal incision, the peritoneum not having been included in the sutures. Two quarts of blood escaped into the peritoneal cavity. Peaslee, in reporting these cases, remarks that in one of his own cases 4 ounces of blood were lost from the incision during the second night.*

Christopher Martin says that hæmorrhage from the abdominal wound can only be serious in 'bleeders'; he himself watched a patient who had undergone the operation of removal of the spleen for leucocythæmia slowly die from hæmorrhage, each stitch-hole bleeding like a wounded vein.

We have seen alarming symptoms due apparently to a small intraperitoneal loss of blood augmented by hæmorrhage from the cervix, which was repaired previous to the cœliotomy.

Symptoms.

The symptoms of post-operative hæmorrhage vary within wide limits, inasmuch as the hæmorrhage may be capillary and due to a mere oozing, or it may arise from the sudden liberation of a large vessel, such as the ovarian or the uterine artery; while, again, it may be due to the escape of blood from several small arteries in a pedicle.

* Deaver says that he is aware of a case where, in closing the abdominal incision, a puncture of one of the deep epigastric veins was made, and this led to the death of the patient from hæmorrhage ('Appendicitis,' second edition, 1900, p. 256).

If the hæmorrhage is immediate or intermediary, and is due to oozing, many hours may pass before the patient loses sufficient blood to cause symptoms that are able to be differentiated from the symptoms of shock so often present after prolonged operations.

In the days when the glass tube was in use, it was no uncommon thing to suck large quantities of blood through the tube for forty-eight hours after the operation. Keith gives an instance when 16 ounces were removed by the sucker in the first ten hours after a section for an adherent ovarian cyst. Now that the drainage-tube is a thing of the past, we must rely on the patient's symptoms to guide us.

Usually the amount of blood lost from adhesions or from a bared surface will not amount to more than 4 ounces, and such a loss will not give rise to any symptoms indicative of hæmorrhage.

If, however, the hæmorrhage continues, then—judging from the symptoms that patients formerly exhibited when wearing a tube—the pulse will gradually increase, while the temperature will remain normal or subnormal; the respirations will also increase to 24 or 26, and the patient will suffer from 'air-hunger.' The extremities will be cold and the patient's face blanched, while the pulse may increase to 120 or more.

Such oozing may not threaten the patient's life from hæmorrhage, but it is, nevertheless, of importance, inasmuch as it intensifies any symptoms of shock that may be present, and the blood may form a focus from which a pelvic abscess will develop.

Smyly, quoting Zweifel, says: 'If, on the other hand, even a small hæmorrhage goes on, it works against the heart's action both dynamically and reflexly. When the latter improves, the hæmorrhage increases; as more serum flows into the circulation, the blood becomes more watery, less coagulable, and thus less adapted to the spontaneous closure of the bleeding vessels. The heart working with a half-filled circulation, aggravated by even a small continued loss, he likens to a steam-engine working a ship's propeller which lifts out of the water, or a locomotive when the wheels slip upon the rails. The mechanism is imperfect, having lost its accustomed grip; it resembles a pump insufficiently supplied with water. It is, in fact, an empty pumping heart, which authors term "shock."'

In the secondary hæmorrhage which occurs on account of the slipping of a ligature, the patient's condition may alter quite suddenly; in fact, she may start up and cry out with the pain due to the rush of blood into the peritoneal cavity, and if the ligature has slipped off a vessel, such as the uterine artery, her pulse may start up in a moment to 130, her respiration become laboured, her face assume a deathly pallor, and collapse and death follow in twenty or thirty minutes.

Fortunately, the secondary hæmorrhage that we have usually to deal with is not often of this fulminating character.

Usually the course of events is as follows:

The patient, after progressing favourably for twelve, twenty-four, or thirty hours, begins to show signs of a quickening pulse; with this she becomes somewhat restless, or she soon becomes conscious that her heart is beating rapidly, and she cannot breathe with as much ease as formerly; while she complains of a suffocating feeling about her chest, and desires the nurse to open the windows so as to let her have more fresh air. She then begins to feel pain in her abdomen, due to the presence of the blood.

During the first half-hour her pulse runs up 15 or 20 beats, and her respirations increase to 26 or more.

Soon it becomes obvious to the nurse that the patient's face is becoming blanched, it is becoming the colour of used ivory, white with a shade of yellow; her lips lose all their colour; the conjunctivæ grow blanched and the pupils become somewhat dilated; a cold perspiration collects on the brow; while the hands and feet are cold and clammy.

During the second hour the pulse rises to 130 or 140, and the respiration increases to 30. The patient's nostrils now become dilated at each inspiration, and the accessory muscles of respiration are brought into action. The tongue is cold and white above, while the sides have a blue tinge.

During all this time the patient is restless, and her muscles may twitch. At times she throws her arms about, and will never consent for them to be covered by the bedclothes.

She implores the nurse in gasps to open all the windows or she will be suffocated, and then craves for a drink as her mouth is parched. But as nothing gives her relief, she asks to be raised in bed, and when in this position complains that the room is swimming round, or that she feels she is 'going through the bed.'

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Her pupils are now widely dilated; her temperature is subnormal, even as low as 95·7° F.; her breath is perceptibly cold; her hands are clammy, white, and waxy; her pulse is quite thready (160); her respiration, still more laboured and embarrassed, now numbers 40 to the minute; and, fighting for her breath, with pallid face and dilated nostrils she becomes unconscious and dies.

Diagnosis.

In endeavouring to diagnose post-operative hæmorrhage, it is well to keep before our minds—

Firstly, the **slow** hæmorrhage, due to a small artery, torn adhesions, or denuded surfaces.

Secondly, the **fulminating** form, where the blood is poured out with a rush, causing alarming symptoms almost immediately.

Thirdly, the hæmorrhage from **moderate-sized vessels**, when the patient grows gradually worse hour after hour.

The diagnosis of the first variety of hæmorrhage is usually difficult, for if the operation has been a prolonged one and there is much shock present, the pulse-rate may continue high from the outset. But there is one great difference between shock and hæmorrhage: in the former the patient's condition usually tends to improve as the hours pass by, while in the latter case the patient's condition becomes more alarming each hour if the hæmorrhage continues; the pulse, in spite of transfusion, grows more thready, the skin more anæmic, and the patient gets restless and dilates her nostrils with every inspiration. Then we must begin to suspect hæmorrhage if the symptoms present are quite out of proportion to the amount of shock that we could reasonably have expected from the operation.

It has been said that if the skin is attentively watched an irregular local capillary circulation and a congestion may be discovered in patients who are suffering from shock, and that these vascular changes are *not* present in secondary hæmorrhage.

Shock exists usually from the outset, while the symptoms of hæmorrhage occur after some interval has elapsed since the operation, and there has been a distinct interval during which the temperature may have risen and the pulse may have been normal or but slightly increased.

We certainly place great stress on whether the patient lies

still in bed or not. We have seen patients suffering with continued shock twenty hours after a section, and having a pulse of 160, lie quietly in bed, complaining of nothing. But the patient who is bleeding internally never remains quiet. She is for ever twisting and turning and panting and keeping her chin in the air and asking for fresh air.

Late shock, occurring twenty-four hours after an operation, would be a condition difficult to differentiate from hæmorrhage: and considering that late shock is very rare, it would be wise to almost invariably regard such cases as instances of secondary hæmorrhage. If, however, we meet with a patient where twenty-four hours after the operation the pulse is 130 to 150, while previous to this the pulse has not been rapid, and if with this we do not find that she is becoming blanched and has no cold sweats and no muscular twitching or vomiting, and is not very distressed with her breathing, we may decide in favour of late shock; but such cases must be watched most anxiously, and stimulated with strychnine, adrenalin, and ammonia.

In those cases where the patient has been going on satisfactorily for twenty-four hours or more, we should have less difficulty in deciding what is really amiss; for the growing pallor of the face, the increasing difficulty of breathing, and the pulse rising 15 or 20 beats every half-hour, suggests to one's mind hæmorrhage before all other things.

Again, we shall often have an idea whether the case was one in which hæmorrhage was likely to occur.

The condition that may be confounded with late hæmorrhage most frequently is sepsis, and this is especially the case when the symptoms of sepsis set in suddenly. Many an abdomen is reopened under the impression that the case is one of secondary hæmorrhage, but peritonitis is discovered instead. In such cases the symptoms do not show themselves until after the second day, and this fact will aid us; at the same time we must not forget that post-operative hæmorrhage may occur at any time during the first eight days. Peaslee showed that in his day one-half of those who died of hæmorrhage perished within twenty-four hours, and seven-eighths within seventy-two hours.

Hæmorrhage from a large vessel like the uterine artery will always cause such a profound alteration in the patient's appearance in a few minutes that we can never mistake it for anything

but pulmonary embolism. There is, however, this to be remembered in these two conditions, that embolism is rare during the first days that supervene after an operation, while the longer the patient goes after the operation the less likely are we to get hæmorrhage.

Treatment—Prophylactic.*

While secondary hæmorrhage may occur in the practice of an experienced surgeon, it is undoubtedly more common in the practice of the inexperienced. This is often due not to inferior technical dexterity on the part of the younger surgeon, but to a proper appreciation of the very great importance of perfect hæmostasis.

We shall, therefore, briefly refer to some points to which the young surgeon's attention should be drawn, in order that he may at the outset regard complete hæmostasis as the factor that is to be placed in the balance with asepsis in abdominal surgery. He must remember that a neglected torn adhesion may lead to a fatal result quite as effectually as the slipping of a ligature off the uterine artery.

1. Treatment of Adhesions.—If we have the erudite touch of Martin, of Berlin, who breaks down the most extensive adhesions in a few minutes, separating densely adherent tubes with a rapidity and violence that is astonishing to behold—if we are skilled enough to do this, the mere violence of the manipulation will be a safeguard against much oozing; but he who tries to finish such cases in nine minutes—as Martin does—must be prepared to incur the risk of tearing the hollow viscera.

Adhesions fixed to the anterior wall of the abdomen are generally dense, but do not bleed very much, unless a large vein is opened. Omental adhesions, however, bleed furiously at times. The vessels in the omentum become very enlarged, and so thin-walled that they will not carry a ligature. It is then necessary to follow them up for a little distance and tie them where they are thicker, including a small portion of omental tissue to form a pad. Greig Smith and Thornton have pointed out that vessels coming from solid vascular tumours do not contract on division, and if they are divided furious

* If the patient is jaundiced, we may begin to administer chloride of calcium for some days before the operation, and give 60 grains immediately after the operation by the bowel.

hæmorrhage may take place; and if such vessel be not tied, fatal hæmorrhage may result.

We cannot be too careful with the omental vessels, and we must exercise great care in applying ligatures to the structure. If much omentum has to be separated off we should pick up about an inch at a time, pass an aneurism needle through a space devoid of vessels, taking care to tear an aperture $\frac{3}{4}$ inch in length. After tying off this first portion, the needle is again inserted in another clear area an inch distant from the first tear, and another aperture is made in the omentum, a ligature introduced, and this portion tied off. Ligature after ligature is thus introduced, and the whole omentum may be traversed in a few minutes. After cutting away the distal portions, the proximal extremity is laid on a gauze sponge, and we can quickly ascertain then if we have overlooked any bleeding points.

Oozing from a uterus from which adhesions have been peeled off may be very persistent.

It may be checked by applying a very hot sponge or a little dry sulphate of iron, by touching the parts with the Paquelin cautery or aristol, or by painting the surfaces with absolute alcohol or a solution of suprarenal capsule or adrenalin;* lastly, it may be necessary to insert fine sutures, which are drawn only moderately tight. We have lately used sterilized hazeline with good effect; this is applied by a sponge.

When we are dealing with a persistent oozing from a denuded area on the bowel wall, we should endeavour to control the hæmorrhage with fine sutures introduced with a round needle, and to use a fold of peritoneum to cover the part with.

The oozing that occurs after an extensive enucleation in the depths of the pelvis is best treated by pressure exerted by packing a number of hot sponges into Douglas's pouch, or by washing out the pelvis with hot water (110° F.); or, if it still persists, a roll of gauze must be packed in.

We have often observed very troublesome and persistent hæmorrhage in those cases where the lower or posterior surface of the broad ligament has been torn and a large vein has been opened. We have seen such profuse hæmorrhage from such a cause as to necessitate the opening of the abdomen again. In these cases, if a ligature cannot be placed on the bleeding-point, we must rely on gauze packing. One useful manœuvre

* Peroxide of hydrogen always increases oozing.

may always be tried. A suture is inserted by means of a curved needle as close to the bleeding spot as possible. This is tied and the end is pulled up, and another suture is inserted a little beyond the first. By gradually progressing in this way we can often control a bleeding spot which before defied us.

Before closing the abdominal cavity we should always lower the patient to the horizontal position if we have had her in the Trendelenburg position. It is often surprising how surfaces that before showed no inclination to ooze now begin.

Lastly, before closing the abdomen we should always make a thorough inspection of the field of operation, and insert a sponge on a holder to see if it becomes deeply stained.

2. **Treatment of the Pedicle.**—The extra-peritoneal treatment of the pedicle in the days gone by was often attended

FIG. 128.—Diagram showing the Different Methods of Securing the Vessels in Broad Ligament Pedicles.

by secondary hæmorrhage, which came on even as late as the fourteenth day.

The tying off of the broad ligament by transfixing it with two ligatures which are tied in opposite directions has been undoubtedly the chief cause, during recent years, of secondary hæmorrhage in section cases. Consequently, when dealing with broad pedicles, or when removing a tumour that is sessile, the pedicle should be tied by inserting a ligature beneath the ovarian artery near the pelvic wall, and then inserting another close to the cornu of the uterus. After removing the tumour, any vessels that are seen spouting may be caught and tied separately. This is simply applying the common principles of the general surgeon to a particular region; it is good surgery, it is founded on sound principles, every day it is gaining in favour, and it is attended by good results.

The accompanying diagram will help to show how much more

easily the ligature can be disengaged from the pedicle when the interlocking ligature is used than when separate ligatures are used. For it is obvious that since A is a fixed point at the pelvic brim, any traction on the uterus (U) will tend to disengage the pedicle (P) from the upper division of the ligature (B), whereas no amount of traction on the uterus will have any effect on D and G (Fig. 128).

In dealing with a thick œdematous pedicle, we may adopt Bancroft's plan of squeezing it between the blades of a powerful forceps, so that the ligature may be inserted on the proximal side of the forceps, for the ligature may be drawn more firmly provided the assistant takes off the forceps at the moment that the operator begins to tie the threads. In tying off the broad ligament in dealing with myoma of the uterus, it is a common plan to place a pair of forceps on the broad ligament close to the uterine horn. If a ligature is inserted so as to include the ovarian artery, we should take the precaution to gradually divide the tissues between this ligature and the forceps whilst we are tightening up the ligature, as each successive cut will enable the ligature to be drawn more tightly, and we shall be more sure of a secure ligature.

Mr. Walter Edmunds, in discussing Doran's paper on 'Ligature of the Pedicle,'* said that 'the reason that the ligature did not sufficiently compress the bleeding artery might be (1) that the loop was loose; (2) that the knot had become undone; (3) that the pedicle had slipped out of the loop. The loop might be loose because the elasticity of the pedicle had distended the loop after the first hitch only had been tied, when the ends of the ligature were relaxed (as they must be) to complete the knot. The difficulty could be met by using two ligatures side by side, and tying and drawing tight the first hitch on each simultaneously, by which means the resistance to distension would be much increased, or one ligature could be held tight while the other one was tied. The loop might be loose in another way; if the pedicle were tied in three parts, and the ligatures crossed and the two outer ligatures held first, the needle would be held at two places, and could not be satisfactorily tightened. The knot might come undone by the ends being cut too short, or by the ligature breaking as the knot was completed. The boiling of silk in an antiseptic solution materially weakened it, and made

* *Trans. Obstet. Soc. London*, vol. xxxv., p. 147.

it advisable before using it to test it, not merely by pulling on it, but by tying a knot in it and then pulling; this would make it much more likely to break, and if it did so it would be at the knot. If, therefore, the ligature should break in tying the pedicle, it would be at the knot, which, if left, would come undone. Lastly, the pedicle might slip out of the loop; this might be due to it's having been cut too short, or to the loop being too loose (the first hitch having slipped), or to the ends of the knot having been pulled upon; to prevent this it was advisable to cut off the ends as soon as the knot was tied.'

3. **Treatment of Large Vessels.**—In performing abdominal hysterectomy it is a good plan to use silk for the ovarian and uterine arteries, and to apply two ligatures to each vessel.

We do not expect secondary hæmorrhage after the first few days from a long and tortuous artery such as the ovarian; but it is different with the uterine artery, which is short, and feels the full force of the pressure from the iliac vessel.

Treatment—Operative.

The line of treatment that the surgeon will adopt in a case of suspected post-operative hæmorrhage will depend upon the history that the nurse will present to him, taken into conjunction with the condition of the patient when summoned to her bedside.

Bearing in mind that blood is coming from adhesions or from a denuded surface, from a single large vessel such as the uterine artery, or from several small vessels that may be in one pedicle, he will recognise that the history that the nurse supplies of the patient's progress from the time of the operation is of the greatest importance.

We should, in the first place, consider the operation that has been performed, and ask ourselves, Did we anticipate some hæmorrhage?

We must recall the condition of the patient when placed in bed after the operation. If her pulse was below 100, and the nurse tells us that she soon regained consciousness and became warm, but as hour after hour passed by the pulse grew faster, softer, and smaller, and she became pale; that the respirations became increased in number; that her extremities grew cold in spite of hot bottles; that her temperature is now subnormal;

that she has continued to get more restless, and wishes her head to be raised, then we can, with such a history, only suppose that the patient is suffering from hæmorrhage, and that the flow is from one moderately-sized vessel, or from a number of small ones. But on this latter point we are in doubt, and it is this doubt about the size of the vessels that must make us act with caution.

To open the abdomen at once would be unwise, firstly, because if the patient is strong and has not already lost much blood she will stand the loss well, and there is a natural tendency for the hæmorrhage to cease as the patient becomes weaker, unless the open vessel is of considerable magnitude ; secondly, if the patient has already lost much blood during the operation, we should wait for some little time to become more certain, because if the patient, on being opened, is found not to be bleeding, but to be suffering from shock, then the second operation would turn the balance against her. Much depends, however, on the patient's physique. Holland* reports a case where, after removing two adherent ovaries, he reopened the abdomen for secondary hæmorrhage. A few hours later the hæmorrhage recurred, and he opened her again. Later on he reopened the abdomen, the fourth time in twenty-four hours, to find a missing sponge, but without success. The patient recovered !

The first thing to be done is to remove the dressings and to see if anything unusual can be noted. If we are employing a gauze drain the dressings may be saturated and deeply stained, and if the drain is pulled up a little there may be quite a flow of blood.

If there be no drain, then palpation or percussion will usually be of little assistance. Blood poured out into the peritoneal cavity gives rise to pain, but as the patient is already in considerable pain from the operation, this does not help us.

A vaginal examination, however, should always be made so as to try and distinguish between extraperitoneal and intraperitoneal hæmorrhage.

Christopher Martin says that 'it is sometimes easy in thin patients to detect the presence of free blood in the peritoneum. If the blood is clotted it is felt as a soft, boggy, ill-defined fulness in the lower abdomen, dull on percussion. If it remains

* *British Gynæcological Journal*, vol. vii., p. 179.

fluid there will be dulness in the flanks, changing in position as the patient is turned from side to side. Distinct fluctuation may be made out. On vaginal examination the soft boggy collection of blood may be felt filling the pouch of Douglas. In cases where a broad ligament hæmatocele forms, the physical signs are very definite. There is felt rising out of one side of the pelvis a tense, firm, fixed, dome-shaped mass, which may or may not exhibit fluctuation. *Per vaginam* the same mass will be felt crowding the uterus forward and to the other side of the pelvis, and limited sharply below by the pelvic fascia.'

Having examined the abdomen and vagina, the binder is readjusted, and the foot of the bed is raised 12 inches.

The surgeon now observes the colour of the patient's lips, tongue, conjunctivæ, and skin, and compares them with the colour noticed after the patient was first placed back in bed.

The pulse-rate and temperature are now taken, and the surgeon seats himself at some little distance from the patient and watches her minutely; in some cases he will make up his mind in a few minutes, in other cases he must be content to watch.

If the patient is lying on her back without a pillow at her head, and with the foot of the bed raised, the observer will soon see that she is restless and uncomfortable. She cannot keep her chin down close to her chest, but always has it stuck up so that she can breathe with more ease. She does not keep still, and her arms are not kept under the bedclothes, and in all probability her nostrils are dilating with every breath. She will soon beg the surgeon to allow her to have something to drink, and she will beg to be raised in bed.

This thirst, this restlessness, this desire to be raised up, are points always to be looked for.

From time to time the pulse-rate is observed, and if it has reached 140, and in an hour it is found still more rapid (145), while the pallor is increasing, the surgeon should not wait for the classical signs and symptoms to develop. Even if he is not quite convinced he is dealing with a case of hæmorrhage, he should give the patient the benefit of the doubt, and reopen the abdomen without further delay.

But often, after watching a patient attentively for fifteen or twenty minutes, one is still in doubt, for the pulse remains the same, the anæmia does not increase, and she may even improve

in appearance. We should not reopen the abdomen under such circumstances; we should proceed as follows:

Inject 1 drachm of tinct. digitalis in 30 ounces of saline solution into the axilla.

Inject 5 minims of adrenalin and $\frac{1}{20}$ grain of strychnine subcutaneously. Give a nutrient enema of Carnrick's liquid peptonoids—2 ounces in 2 ounces of saline solution.

Then the surgeon again takes up his position to watch the effect of this treatment.

If the patient is suffering from hæmorrhage from a pedicle, this treatment will have little effect on her; it will not cause the hæmorrhage to cease; if anything, it will increase it, and the patient's breathing will soon become more distressed, and the anæmia will increase.

On the other hand, if the patient's condition has been due to extensive oozing, this injection of saline may be quite sufficient to turn the balance in her favour, and she will slowly improve.

Having decided to reopen the abdomen, we should remove the patient to the operating room, or if we are in a private house we should have her placed on a table. She should be surrounded by hot-water bottles and an anæsthetic (ether) administered.

The dressings covering the wound are removed; the skin is washed with warm water, and then quickly rubbed with peroxide of hydrogen.

At first the whole wound should not be opened. If we have used through and through sutures of silk gut it will be sufficient if we remove three of these. The sides of the incision are then held apart with long, narrow retractors, and the peritoneum is picked up and opened with care.

If the hæmorrhage has been a severe one, as soon as the peritoneal cavity is entered the blood will rush towards the opening, and in some cases actually spurt up.

If, however, we are at first unable to see any evidence of hæmorrhage we should insert a large glass catheter, and push it gently down into Douglas's pouch; to the proximal extremity of this we now attach a short piece of rubber tubing, which is in turn connected with a glass syringe. If there has been any bleeding we shall be able quite easily to fill the catheter and syringe with blood. If, however, we are able to suck up no blood we may insert a wide glass drainage-tube, and again try with the catheter and syringe.

If we get evidence of hæmorrhage—4 ounces in anæmic women and 10 ounces in strong women are about the minimum quantities that will cause sufficient symptoms to make up a picture of secondary hæmorrhage—we should at once enlarge the incision by removing more sutures, and we should give ourselves as much room to work in as possible.

As soon as the abdomen is opened we seek for the bleeding-point. If there has been a profuse hæmorrhage, we shall be unable to see anything distinctly until we have ladled out some of the blood and clots.

Whilst doing this we should tell one of the nurses to get the transfusion apparatus ready, so that the saline may be transfused while the surgeon is at work; it may even be necessary to put the cannula into a vein.

After ladling out some of the blood, the intestines are pushed up and a few gauze sponges inserted, and the patient may then be raised into the Trendelenburg position.

If the case has been a hysterectomy, we should first seek the ovarian artery on either side and endeavour to see if the stream of blood is coming from the pedicle close to the pelvic wall. After this we proceed to seize the stump of the cervix with a pair of claw forceps, taking care not to seize the bladder at the same time. The cervix is slowly pulled up towards the incision, and each uterine artery is palpated and then sponged so as to clear the field, and we endeavour to catch the bleeding area in a long pair of curved forceps.

If the operation has been performed for the removal of the appendages or for an ovarian cyst, we at once seek for the fundus uteri and seize it with a volsella, or seize the broad ligament near the cornu uteri with a pair of cyst forceps, and slowly elevate the uterus to the abdominal incision so that we may the more easily examine the pedicles; and when the bleeding-point is located, a clamp may at once be applied to stop all further hæmorrhage.

We should now consider the patient's condition. If her pulse is satisfactory, we may proceed to secure the bleeding-point with a ligature; but if the patient is in a critical condition, we may leave the forceps attached to the pedicle, lower the patient to the horizontal position, pour in a few pints of saline to wash the superfluous blood away, close the incision with through and through silk-gut sutures inserted by means of a handled needle, and without further delay place the patient in bed surrounded

with hot blankets and bottles, and continue the transfusion. An enema of carbonate of ammonia and digitalis may be given by the bowel, and strychnine and ether may be injected subcutaneously.

We have on several occasions, when dealing with pedicles that were so soft that they would not allow a ligature to be applied, placed forceps in the tissues and left them protruding through the abdominal incision for forty-eight hours. This was a plan that Mr. Tait frequently employed with great success.

In those cases where the patient's pulse is in a good condition, we should always flush the peritoneal cavity with saline solution, lest the blood-clots left behind should form foci for septic processes.

In some instances we shall not be able to find any hæmorrhage from the uterine or ovarian pedicles. We must then clean out all the blood-clots from Douglas's pouch, and dry the surrounding tissues with sponges on holders.

After this an electric-light lamp should be employed to illuminate the depths of the pelvis, to see if the bleeding is coming from adhesions, or a bared surface, or a torn vein in the posterior surface of the broad ligament.

If the bleeding cannot be controlled by a suture, we may insert gauze into Douglas's pouch, and apply counter-pressure by packing the vagina firmly, and after closing the abdomen the surgeon should place a small layer of dressing on the wound, and should then resort to a plan frequently adopted by Mr. Tait. He was accustomed to take a number of small rolls of gauze and build them into a pyramid on either side of the median line. Over these pyramids he would lay some cotton-wool, and then tighten the binders. By this means, in a thin patient he could exert a very considerable pressure on the abdominal contents, which no doubt helped to confine the blood to the pelvis and aided clotting.

Instead of using gauze pressure we may first try swabbing the surface either with absolute alcohol, hazeline, a solution of suprarenal capsule and chloretone, or by touching the area with the cautery heated to a dull-red heat. But we may have none of these at hand; in that case we may mop the part with perchloride of iron. Mr. Tait frequently used the solid crystallized perchloride with success. A thin layer of powdered persulphate of iron may also be of use.

If the operation is performed in a private house we may have no styptics at hand; we must then rely on very hot water, and if this fails the pelvis must be packed with gauze.

If there be much blood-clot present it is well to remember that a large clot may find its way into one of the renal fossæ, and there cause future trouble.

If the secondary hæmorrhage has arisen from many different points after the removal of a malignant growth, it may be necessary to tie the internal iliac artery. This is done by first locating the common iliac, then the bifurcation; after that the peritoneum is incised, the ureter located, and the artery tied, care being taken not to injure the vein.

If we can find no bleeding surface on the pelvis we should then examine the omentum.

As recorded above, injury to large veins in the omentum has been the cause of secondary, and even fatal, hæmorrhage.

A patient who has had a severe secondary hæmorrhage may progress favourably for some hours after the second operation has been performed, and then show signs of collapse. Strychnine, ether, and digitalis may be injected at once, and we may again resort to saline infusion with great benefit, for there are no cases that show such excellent results after the transfusion as cases of hæmorrhage.

For days and weeks afterwards the patient must be carefully watched. Usually they suffer intensely with headache, and if an endeavour is made to 'feed them up' they suffer from acute indigestion and great distension.

They should be given peptonized milk and Benger's food for some days, then weak soups thickened with Benger's food; after this oysters, fish, and sheep's brains. Potatoes, bread, meat, and tea are to be avoided.

They may, however, take a little pigeon, raw-meat juice, maltine, and porter, also Stearn's wine of cod-liver oil and iron.

CHAPTER XXXVI

TYMPANITES—PSEUDO-ILEUS

Tympanites.

It is a fact familiar to all surgeons that there is a decided tendency to tympanites after any operation in which the peritoneal cavity is opened, and at the same time it is also a fact that the less the intestines are handled, and the less their peritoneal coat is allowed to dry, the less will meteorism complicate the after-treatment, provided that the case is not already, or does not become, septic. Thus, after a hysteropexy performed with the patient in the Trendelenburg position, when the intestines are hardly touched or exposed, we have a minimum distension; but after an extensive enucleation of a large ovarian cyst with intestinal adhesions, the patient's bowels become markedly distended during the first forty-eight hours after the operation.

This distension cannot be simply due to the patient lying on her back, to her swallowing air, or to the decomposition of the intestinal contents, inasmuch as this distension is not a feature in operations performed on regions other than the peritoneal cavity, and in which these same factors are present and are free to act. The tympanites is in some way intimately associated with the opening of the peritoneal cavity.

The gas that forms after a section collects either in the stomach or the intestines, and it is important to distinguish the locality of the distension, and to ascertain whether the stomach, the small intestine, or the colon is the chief seat of distension.

Epigastric distension alone may be due to a collection of gas in the stomach, while the rest of the abdomen may be flat. This is a condition that usually causes no alarm, and is not uncommon after the simplest sections.

It may be a natural condition, and due to chronic dyspepsia, or it may be due to the patient swallowing air.

In other cases the distension is due to gas and to transuded fluid, and Von Herff* has recorded a case to show that ileus may be caused by extreme distension of the stomach, which causes kinking of the duodenum; and Ferguson reports a case of acute gastrectasia—'the stomach literally filled the abdomen.'†

Distension of the umbilical and hypogastric regions occurs with shock and ileus, and it is also the signal of commencing peritonitis and pseudo-ileus. The distension begins gradually at the median portion of the abdomen, between the umbilicus and pubes, rising in a gentle curve which drops more abruptly as it approaches the epigastrium. After the stomach begins to dilate, a small hollow is found in the epigastric region, which separates the umbilical distension from the gastric, and another dip is found between the gastric region and the sternum. As, however, the distension increases the colon is dilated, so that the lateral regions of the abdomen become distended, and the median abdominal curve ascends abruptly from the sternum towards the umbilicus, and then slopes more gently towards the pubes; such is the distension of peritonitis and pseudo-ileus when these conditions are well advanced.

Thus, by attentively regarding the abdomen we are able to appreciate not only the degree of tympanites, but by noting which areas are distended we shall be able to tell the stage of the complication, and even surmise the cause of the distension.

We may go even further, and by palpation we may ascertain that in a case of what may be called simple distension—that is, in one in which the after-events show that the distension was not a symptom of infection—we shall find that in all its stages it is a **soft** distension; while in peritonitis the distension rapidly becomes **hard**, because the slightest pressure causes an increased contraction in the already rigid muscles of the abdomen, and also because of the quantity of gas present in the intestines.

Again, in a **soft** distension we may palpate without causing the patient much distress; with a **hard** distension the slightest pressure causes her to shrink. During the final stages of peri-

* *Centralbl. f. Gynak.*, No. 40, 1899.

† *American Journal of Obstetrics*, August, 1902, p. 247.

tonitis we, however, get a hard distension—*i.e.*, great distension—but with no pain on pressure. This condition is due to paralysis of the gut, and is almost invariably a fatal sign.

Greig Smith makes the following remarks on distension of the bowels: 'The degree of distension varies again according to the duration of the case. It takes time to distend the normal abdominal parietes. Tension may arise to an extreme degree in a few hours in one case, with an abdomen not much distended after several days; in another, there may be enormous distension with little tension. From the symptomatic point of view, the observation of these points is of importance; the degree of meteorism is to be measured as much by the pressure it exerts as by the distension it produces.

'Where the individual coils are visible or palpable through the parietes, signs of importance may be observed. If the coils never move or contract, but lie passively distended at one point, we may infer complete paralysis and almost certain virulent inflammation. If, on the other hand, even if there is extreme distension, there is active movement in the bowel, a more hopeful prognosis, with or without operation, may always be given. During these movements various sounds of splashing or gurgling may be heard all over the room or by the stethoscope. Their value here is chiefly in prognosis; in obstruction from mechanical causes they have another value in diagnosis as well.'

Before proceeding to inquire into the etiology of tympanites, we may consider the following general statements:

1. The gas that is found normally in the stomach and intestines is augmented by the air that has been swallowed, by gas that has accumulated through peristalsis failing to expel it, by the gastro-intestinal mucous membrane failing to absorb it, by the gastro-intestinal mucous membrane secreting it, and by the fermentation of food.

2. In health and disease the stomach and intestines contain some gas; tympanites is, therefore, a condition of degree.

3. With a quantity of gas contained in the intestines, and which is prevented from escaping by the action of the anal and pyloric sphincters, we may at times get a perfectly flat abdomen with no signs of distension; while with the same quantity we are able to get a distension of the intestines when the muscular contraction, which gives tone to the intestinal walls, is interfered with. The tone being lowered, the contained gases, being nor-

mally under considerable pressure, expand; the expansion is influenced by the temperature of the body.

4. Tympanites is, consequently, a distension of the bowel produced by the failure of the muscular tissue of the bowel wall to overcome the natural expansile property of the contained gases, and, consequently, tympanites need not necessarily imply any increase in quantity—but merely an increase in volume—of the gas contained in the intestines. The distension of the intestines will go on until the gas, by increasing its volume, has diminished its pressure, and then the muscular contracting force of the circular layer equals the pressure outwards of the contained gas.

5. If, however, the gas is increased both in quantity and volume, then the time will come when the pressure outwards of the gas overcomes the pressure inwards of the circular muscular layer.

Provided that the gas is not increased continually in quantity, it follows that up to a certain point the muscular tissue of the bowel will continue to exert an active pressure—the bowel wall will still have tone—and if the contained gas is caused to escape by the anal or pyloric openings, or by an artificial opening, then the bowel will immediately contract on the remaining gas. If, however, the gas does not escape, and the quantity and volume are still further augmented, the pressure outwards becomes so great that the bowel wall is overexpanded and the muscular tone is abolished, and then the bowel comes into the same condition as if the nerves were paralyzed; it cannot contract, peristalsis is abolished.

In short, tympanites either depends for its causation on an increase in the quantity of gas in the bowels, or on a decrease in the muscular tone of the intestinal wall, or, lastly, from a combination of these two conditions.

After a section the following circumstances favour the accumulation of gas in the intestines and stomach:

(*a*) The patient lies on her back, and the abdominal walls are kept as still as possible by the patient, aided by the binder and strapping, so as to avoid the pain that would arise if the abdominal muscles were brought into action. Thus the bowels are deprived of those accessory muscular movements that help peristalsis, and so gas tends to accumulate.

(*b*) Patients who are suffering from thirst endeavour, by re-

peatedly swallowing small quantities of saliva, to moisten the pharynx, but in doing so they swallow air, which accumulates in the stomach.

(*c*) The occurrence of peritonitis and the administration of morphine will tend to paralyze the muscular coat of the bowel, and diminish its peristaltic power, which allows of a passive dilatation by the gas; and this inhibits the absorption of gas through the intestinal bloodvessels, and also favours the retention of the bowel contents, and so predisposes to fermentation, with increased production of gas.

(*d*) Tympanites is usually a marked feature in those cases where the operation has been an imperative one, and where no time has been given to properly prepare the bowels and empty them of their fermentable contents, such as carbohydrates and cellulose.

(*e*) Some patients being chronic dyspeptics, the intestines are normally in a distended condition, especially if salines have been administered. These patients are frequently unable to drink milk, and if it be given to them after the operation, they become distended, probably from the liberation of large quantities of hydrogen, due to the butyric acid fermentation of lactic acid.

(*f*) Hysterical women often swallow air, while others have a spasmodic condition of the sphincter ani, which will not allow the colon to empty itself unless the rectal tube is passed. Both these factors cause an accumulation of gas in the stomach and intestines.

Now, while the above factors are, no doubt, all of some importance as contributory causes from time to time after the operation is completed, it is of importance to endeavour to ascertain the causes that originate during the performance of the operation, because, as we have mentioned above, the length of time and the nature of the particular abdominal operations largely influence the occurrence of tympanites.

Causes originating during the course of the operation will act by disturbing the nervous system directly or reflexly, and, as a result, the visceromotor elements of the intestinal cavity are influenced.

Malcolm holds that in the exposure and manipulation of the intestines during the course of a section there is abundant cause for its temporary paralysis, inasmuch as every stimulus causes

at first an increase of muscular activity; but when the stimulus is strong or prolonged, it induces paralysis from exhaustion of nerve energy, which can only be recovered from after a period of rest.

This view is, no doubt, abundantly simple; but in order to comprehend what it so simply states, we must glance at the complex conditions that underlie peristalsis and the present state of knowledge with regard to the influence of the nervous system on intestinal movements.

The bowel has two movements, one a swaying—Pendelbewegungen of Ludwig—the other a peristaltic movement.

The swaying movements are propagated rapidly down the intestine; they occur in isolated loops as well as in segments, which retain their functional continuity. Distension of the gut evokes increased movements; they may be diminished or abolished by cutting off the arterial blood-supply to the intestine. If Auerbach's plexus be paralyzed, the waves are still present in undiminished force; 'they therefore originate in the muscle fibres, and probably are transmitted from one muscle cell to the next' (Starling).

The peristaltic are slower movements than the swaying. If a body be introduced into the bowel, and its presence is sufficiently stimulating, it will be noticed that the segment above the body enters into a strong tonic contraction, while at the same time the intestine for a considerable length below the exciting body is inhibited and relaxed. In consequence of this contraction above the body, and the relaxation of the bowel below, the body within the intestinal cavity is moved downwards, being followed up by the advancing ring of contraction.

'It is evident that the true peristaltic contraction is a co-ordinated reflex, carried out by the local nervous centres in the wall of the gut. By means of the injection of nicotine or the local application of cocaine, we can paralyze the nerve centres, leaving the muscle fibres intact. We then find that although the rhythmic contractions are even better marked than before, running up and down the gut with a rapidity of 2 to 4 centimetres per second, they are totally unaffected by the application of a strong stimulus to the intestine, either above or below the segment which is under observation. Since the double effect of local stimulation, augmentation above and inhibition below is wanting; the power of the intestine to move its contents in any definite

direction is also gone. A bolus placed in any part of the paralyzed loop remains absolutely motionless.'*

Turning now to the influence of the nervous system on intestinal movements, we find that the intestines derive their nerve-supply from the enteric nervous system, consisting of the plexus of Auerbach and Meissner; a supply from the spinal cord by way of the sympathetic chain, great and small splanchnics, and solar and mesenteric plexus; and, lastly, fibres from the vagus.

The exact rôle that each of these groups of nerves plays in the movements of the bowel is far from settled. At present the vagus is considered to reach the intestine from all points, the nerve containing two sets of fibres to the muscular coat of this intestine—one set inhibitory, and the others augmentor or motor.

The sympathetic supply reaches the intestines by means of the splanchnic nerves. Many experiments point to the conclusion that these nerves inhibit intestinal movements; that the inhibition is not due—as Maffer and Basch imagined—to their vaso-constriction influence on the intestines; that in some cases stimulation of these nerves shows augmentation of intestinal movements, in other cases inhibition, while in some cases augmentation is followed by inhibition; that the intestinal inhibitory fibres of the splanchnic take a different course from the vasomotor fibres.

Ehrmann and Von Basch suggest that the splanchnic nerves contain the motor fibres for the longitudinal muscles and the inhibitory fibres for the circular muscles, while the vagus contains the excitatory fibres for the circular muscles and the inhibitory fibres for the longitudinal muscles; but this idea of 'crossed innervation' is not accepted, and is negatived by observations made by Starling and Bayliss.

Bunch's careful experiments show that stimulation of the peripheral end of the cut cervical vagus usually produces no effect on the small intestine, while, on the other hand, he came to the conclusion that the splanchnics probably contain in all animals two sets of nerve fibres, the one set tending to produce increased contraction of the intestine (diminution of its calibre), and the other set diminished contraction.†

Now, while peristaltic movements may go on in an intestine

* Starling, 'Text-book of Physiology,' edited by Schäfer, vol. ii., p. 329.

† Bunch, *Journal of Physiology*, vol. xxii., 1898; London and Cambridge.

when the splanchnics are divided, and may even go on when the gut is removed from the body, it is absolutely certain that in order that the intestine may have the power to move its contents in any definite direction it is necessary that the plexus of Auerbach should be able to act, in order that it may bring about that co-ordinated reflex which is essential to a true peristaltic contraction.

We put forward the following hypothesis :

1. Every segment of bowel is supplied by splanchnic nerves.
2. Some of these cause an increased contraction, while others cause a diminished contraction of the muscular coat of the bowel.
3. Besides these nerves there are the plexus of Auerbach.
4. Any stimulus (bolus, gas, fæces) within the bowel when sufficiently strong causes one portion of the gut above the point stimulated to contract (through the agency of the splanchnics), while the part below the spot irritated is relaxed (through the agency of the splanchnics, which diminish contraction). These effects of local stimulation, augmentation above and inhibition below, are the result of reflexes co-ordinated by Auerbach's plexus. Consequently, in order that any segment of the intestine may have the power to move its contents in any definite direction, it is absolutely necessary that the plexus of Auerbach should be able to act, so that it will bring about that co-ordinated reflex which is essential to a true peristaltic action.

Reverting now to Malcolm's theory, he supposes that during the exposure and manipulation of the intestines, the splanchnics are at first excited and then exhausted, and this tends to produce a paralysis of the muscular coat of the intestines.

We, however, regard the deficient peristaltic action as due to a failure of Auerbach's plexus to produce the required co-ordinated reflex—*i.e.*, augmentation of contraction above and inhibition of contraction below the point of stimulation—and this failure of the local centre is not due in our opinion to exhaustion of the centre from overstimulation, but it is due to an alteration in the blood-supply of the bowel produced during the course of the operation by exhaustion of the vasomotor nerves of the splanchnic area.

Let us, then, inquire if there are any facts which warrant us assuming that an alteration in the circulation of the intestinal wall will affect peristalsis, and so influence tympanites; and if a

vasomotor change can be shown to be one of the causes that effect peristalsis, let us then inquire if there are any vasomotor changes during a section that can be considered sufficient to account for the temporary abeyance of peristalsis after these operations.

We need not quote examples at length to prove that an alteration in the blood influences peristalsis, because these examples are familiar to everyone. The well-known experiments of clamping the aorta, and the results following the release of clamp; the experiments of Ludwig and Salvioli on the effect of blood when fully supplied with oxygen as opposed to blood which has become venous; the experiments of Lauder Brunton of injecting opium into the blood-stream; the marked peristalsis that occurs on the approach of death; the effect of continued congestion of the intestinal blood; the effect of arterial blood admitted into the vessels of the exhausted intestine, and innumerable other examples, leave us in no doubt that the quality of the blood supplied to the intestinal walls has a marked influence on increasing and decreasing peristaltic action. While neither the paralysis of Auerbach's plexus nor the isolation of loops from the rest of the intestine has any power to diminish the force of the waves in the swaying movements of the bowels yet these movements may be diminished or abolished by cutting off the arterial blood-supply to the intestine.

All observers agree that while the activity of the intestines may be modified or called into play by a number of local conditions, 'chief among these are to be reckoned changes in the circulation' (Starling); and when circulatory disturbances persist for a long time, they finally produce exhaustion of the muscular layers and complete arrest of peristalsis' (Hemmeter).

The following facts show that an altered circulation has a marked influence in causing tympanites.

If we have thrombosis of either of the mesenteric veins, the bowels become speedily distended with gas.

If the blood-supply to a segment of bowel be greatly diminished, 'the whole of the intestine so treated becomes rapidly dilated with gas, and a condition of widespread meteorism is produced' (Treves).

Kader's experiments demonstrate 'that gas may be developed in an intestine emptied of its contents, and that meteorism as met with in disease depends almost entirely upon gross dis-

turbance of the circulation of blood through the affected portions of intestines' (Treves).

It may be taken as granted, then, that certain alterations in the quality and the quantity of the blood supplied to the intestines can largely influence peristaltic action and tympanites.

We shall now proceed to show that a profound alteration occurs in the circulation in abdominal operations, and while we shall not attempt to prove that this alteration in the circulation is the cause of the tympanites that occurs after sections, we nevertheless hold that it is extremely probable that it is the main factor.

Numerous experiments have shown that, after handling the small intestine, the splanchnic vasomotor mechanism is disturbed in proportion to the amount and the length of time that the irritation is applied; that during an operation in the peritoneal cavity, and afterwards, the vessels of the mesentery and the hollow viscera become dilated, the arteries pulsating visibly, and the veins swelling; and, if the irritation is long continued, the veins become very dilated and the viscera livid, while the arteries cease to pulsate, and become more or less contracted. These effects continue after the operation is completed for periods which vary in accordance with the amount of irritation applied and the shock produced.

It is worthy of note that irritation applied to the uterus and ovaries and omentum in itself has comparatively little effect in dilating the mesenteric veins; the dilatation occurs, however, if the intestines are not protected during the manipulation.

Manipulation of the intestines causes the vessels of the small intestines to be chiefly affected. Next in order come the vessels of the stomach, while the vessels of the colon are least affected. This accounts for the well-observed fact that tympanites usually begins around the umbilical region, and spreads gradually up towards the stomach, while the colon may not be distended to any extent, or may, through its unimpaired peristalsis, be quite able to expel any flatus that collects in it up to a certain point.

We hold that this interference with the circulation amounts to a venous congestion of the mesenteric veins, and, consequently, of the intestinal villi, and that it is due to an exhaustion of the vasomotor nerves.

Experiments and clinical evidence go to show that with a venous congestion of the stomach and the intestines we always have

an increased degree of distension of the bowels and stomach, and as the veins chiefly concerned here are the superior and inferior mesenteric, we practically have the same condition produced as occurs when we have an obstruction to the flow of the portal blood.

A familiar example of tympanites produced by such a cause is often met with in patients who are affected with malaria, where, with an obstructed portal circulation, we have attacks of extreme flatulence preceding the attack of indigestion to which the patients are so often subject.

The following case may also be cited to show that an alteration in the circulation of the abdominal vessels may be accompanied by great tympanitic distension of the abdomen. It is reported by Weir Mitchell. The patient was a young married woman, and at times she was liable to have an enlargement of the belly. Within a few hours the belly, in place of being flaccid and pendent, was swollen enormously. 'She looked, in fact, as a woman, thin as she was, would have looked at the eighth month of pregnancy.'

Weir Mitchell says: 'When I saw her an attack was at its worst. The woman's pulse was about 165, and was a mere thread, at times imperceptible. Her face and hands were white and cold. The abdomen was tense and red, and could be felt to throb distinctly, while all over it the vessels, veins, and arteries were visibly enlarged. . . . It was clear that, owing to the palsy of the abdominal vessels, all the available blood of a too bloodless woman was for a time in this cavity and its walls. If while in this state she sat up, she instantly fainted.'

The above clinical and experimental evidence shows that vasomotor changes in the intestinal vessels are capable of influencing peristaltic action, and in some instances of causing extreme tympanites. We suggest, therefore, that the alteration in the circulation that occurs after abdominal sections is probably the main cause of the tympanites, and that the alteration of the circulation influences the ganglia in the intestinal walls, and this induces a suspension of their functions.

Now, it is during the first twenty-four hours after a section that distension is not marked, because the circulatory disturbances do not prevent the nerve plexus from having a certain control over the muscular walls of the intestines, and, consequently, although there is always gas in the bowels, it is not in

sufficient quantities to cause marked dilatation of the intestines unless there is a rapid onset of paralysis from virulent peritonitis or after the administration of morphine.

During the second twenty-four hours the quantity of gas in the bowel increases—from one of the causes enumerated above—and if now the bowel wall be still suffering from the effects of the deranged circulation, though it may have recovered somewhat, the muscular contraction is still too weak—from the defective nerve impulse—to prevent the increasing quantity of gas distending the intestines.

Since peristalsis depends on the action of the muscles of the intestine, whose contraction appears to depend immediately on impulses from Auerbach's plexus, we must suppose that the effective action of these nerve centres—as in all other parts of the body—depends on a normal state of the circulation, while a disarrangement of the circulation throws them temporarily out of gear. As the alteration in the circulation in the bowel after a section is in proportion to the amount of irritation applied to the splanchnic nerves, we thus come to see how it is that a short operation such as a hysteropexy, in which the splanchnic circulation is not interfered with to any extent, is not followed by much distension, while prolonged operations in which the intestines are disturbed and handled are usually followed by marked distension. And we must suppose that the beneficial effects that are derived from purgatives in distension are due to the fact that the quantity of gas in the bowel is reduced, but also, and chiefly, to the fact that they alter the state of the circulation in the bowel walls, and this permits the gases to be absorbed by the blood, and allows the nerve plexus to regain its full powers, and so the gas in the intestine can be compressed by the vigorous contraction of the muscular coat. But we cannot imagine that such a favourable result would occur if we adopted the theory of those surgeons who hold that the distension of the bowel is the result of a widespread paralysis of the muscular coat of the bowel.

It may at first sight be urged that if tympanites be in proportion to the amount of disturbance in the circulation, it is in proportion to the amount of shock, and therefore we should get tympanites after all operations in which there is shock, even if the peritoneal cavity be not opened. We do not, however, admit that argument, because Crile's experiments show that it is

'safe to say that excluded splanchnic circulation experiments only prove that the splanchnic vaso-motor factor plays but a part even in such injuries as involve its own area alone; there is no evidence tending to show that in operations in areas of the body other than the splanchnic and genito-urinary the splanchnic factor plays a special part, probably not much more of a part than in any other area of like vascular capacity. Autopsies in experiments in which this area was not involved did not reveal a condition of vascular distension in this area different from that of other areas.'

The alteration that takes place in the circulation is due, of course, to irritation of the vasomotor nerves and centres; but in some instances it is almost certain that the tympanites that occurs after a section is due, not to the vasomotor, but to the visceromotor nerves being permanently affected. This is the case in fulminating forms of peritonitis, when the toxins cause paralysis of the intestine, and we get a paralytic distension without any marked alteration in the circulation.

In less severe forms of peritonitis we may, in the first instance, get an alteration in the circulation, or this may come on later, when we have signs of inflammation. The bowel becomes gradually distended and gradually paralyzed because the inflammation affects the nerves, affects the muscular coats of the bowels, and the distension injures the circulation, and the disturbed circulation favours the distension. Added to these factors there is a poisoning of the musculature, or its inherent nervous apparatus, by the metabolic products of the bacteria (Reichel). We can produce such a condition of paralysis and distension by merely injecting decomposing matter subcutaneously, and this injection is not followed by any of the gross signs of peritonitis.

Olshausen attributes the paralysis of the intestines, in the cases which he describes under the name of pseudo-ileus, to 'the disturbances of the circulation in the walls of the gut which occur after a prolonged eventration and to consequent venous hyperæmia and extravasation in the wall of the gut.' Malcolm admits that these conditions may occur, and says that evidences of vascular changes in the peritoneum are usually found at the autopsy when death is caused by a pseudo-ileus.

Pseudo-Ileus.

This term was first used by Olshausen to denote a tympanitic condition of the intestines occurring after cœliotomy, and due (*a*) to a simple accumulation of gas in the intestines, (*b*) to a paralytic distension of the bowel, or (*c*) to an accumulation of gas due to an obstruction from the gut kinking at a point where it becomes adherent.

The condition of pseudo-ileus was first clearly pointed out by Malcolm* (in 1887) in connection with cœliotomy; but functional insufficiency of the peristalsis of a part of or of the entire intestine, without being caused by a mechanical obstacle, was first recognised by Henrot (1865).

Symptoms.—Malcolm says: 'After an abdominal section, if the temperature and pulse rise for the first two or three days, and they fall well down towards the normal, as if a healthy physiological recovery were about to take place, and if during the fall of temperature and pulse retention of flatus in the alimentary canal occurs, and abdominal distension becomes gradually more obvious, the patient is certainly suffering from obstruction of the bowels or from pseudo-ileus. A feeling of fulness, of oppression of the chest, ensues, and is followed by nausea and vomiting. As the distension of the abdomen increases, sooner or later a rise of temperature and pulse ensues. These, however, do not by any means rise and fall together. On the contrary, the most marked contrasts in the course of the temperature and pulse curves may be observed in the cases under consideration. When the bowels distend and the temperature falls about the third day, the pulse not infrequently remains at its high level; or the pulse may increase in frequency, while the temperature remains steady or falls. For example, in one case, just as distension of the abdomen was beginning at 8 o'clock a.m., the temperature was 100·2° F. in the vagina; the pulse was 100. An hour and a half later the pulse was 120, the temperature 100·4° F. At 1.30 p.m. on the same day the pulse was 130, while the temperature, having been 100·6° F. in the interval, was again 100·4° F.; that is to say, the temperature was very nearly steady for five and a half hours, while the pulse rose from 100 to 130.

'The period at which the rise of temperature takes place is

* 'Physiology of Death from Traumatic Fever,' London, 1893.

also very uncertain, but a rise invariably occurs, sometimes running up rapidly to 104° or 105° F. just before death.

'The pulse and temperature usually follow the same course, as they naturally would do after any operation, until the distension of the bowel becomes so great as to induce symptoms of intestinal obstruction.'

After Malcolm had called attention to this condition, Olshausen and Verchère published papers on pseudo-ileus, and they both considered that when death occurred from paralysis of the bowels after a laparotomy, fatality was due to the absorption of poisonous substances from the alimentary canal, Verchère giving to the process the name of **septicémie intestino-peritonéale.**

Malcolm does not agree with their conclusions, and remarks 'that septicæmia produced by the absorption of poisonous matters from the bowel is not, however, a satisfactory explanation of the signs and symptoms found in the cases under discussion, and its occurrence is quite unproved.'

Malcolm himself thinks that a temporary paralysis is caused by the exposure and manipulation of the intestines, and that a pseudo-ileus may result either from feebleness of peristalsis or from a mechanical obstruction; while death from pseudo-ileus is caused by increased arterial contraction, which is due to a gradual increasing abdominal distension. Olshausen, as we have remarked on a former page, attributes the paralysis of the bowel to a change in the circulation in the walls of the gut.

Our explanation is as follows:

Limited tension of a muscle increases its contraction, therefore the circular muscle of the intestine has an increased action (*i.e.*, peristalsis) where there is (limited) distension of the intestine; overdistension robs the intestine of its peristaltic action.

Now, according to the explanation given by us for tympanites, we suppose that the disturbance of the circulation, although it may be slight—and, in fact, it is observed that pseudo-ileus may follow the simplest abdominal operation—yet when continued for some days it allows the bowels to become dilated, simply through the gradual increase in the quantity and volume of gas which is not expelled. If at this stage we administer a purgative, and the bowels move, the distension diminishes, because the volume of gas is lessened. But if we obtain no action of the bowels, and no flatus passes, then the gas goes on accumulating; and as the abnormal condition of the circulation in the bowel

wall is unaltered, the venous blood causes the muscle fibres to lose their irritability, and the nerve ganglia can no longer exert their energy on the muscular coats of the bowel, and consequently the bowel becomes so dilated that the muscle tone is quite abolished. If at this stage we open the bowel and let out the gas from several sections of the bowel, the patient may recover, if the bowel has not been too long overdistended. It is during this overdistended state, however, that another, and probably the chief, danger supervenes, for the coats of the distended viscus allows a filtration through them of septic micro-organisms, and these enter the peritoneal cavity and cause peritonitis or peritoneal infection, the patient becoming septic because she is dying, and then dying because she has become septic. We must also admit that along with the escape of bacteria from the intestinal canal poisonous products are absorbed into the circulation from the bowel.

Now, it is admitted by all who have had much experience in these cases that, if the abdomen is opened when the case is gradually becoming worse, often no signs whatever of congestion, or of any structural change in the wall of the gut, can be noticed; but when the case has lasted a day or so longer the autopsy shows signs of peritonitis and congestion of the peritoneum. The explanation of this is that until the bowel wall is distended to a certain degree it has sufficient vitality to prevent the escape of bacteria through its walls into the peritoneal cavity, but when the bowel becomes overdistended the bacteria escape, and peritonitis results.

But there are some cases where the examination fails to show any visible signs of peritonitis after death, but peritoneal infection may be present in these cases. We may suppose that the patient has died poisoned by her own bowel contents, as we see in cases of intestinal obstruction, where, although the obstruction may be relieved, the patient does not survive unless the bowel has been emptied of its septic contents.

There are some who argue that the peritonitis found in cases of pseudo-ileus was the cause of the paralyzed state of the bowel, and base their arguments on the carefully conducted experiments of Reichel,* who has suggested that the intestinal paralysis observed after laparotomies is really due to circumscribed infection. He demonstrated that there is a peritoneal infection

* Darm Ausschaltung, *Centralbl. f. Chir.*, 1894.

without any traces of inflammatory changes of the serous covering of the intestine. Multanowsky demonstrated that an interruption of the free movement of the intestinal contents for six hours suffices to permit the transmigration of bacteria through the intestinal walls, and that it is not necessary for the intestinal mucosa to be in any way necrosed to permit of this passage (Hemmeter). Treves vigorously maintains that the cases that are described as dying from 'paralytic distension of the bowel' after cœliotomy died because peristalsis has ceased on account of peritonitis, and he remarks: 'I have never met with an example of such a case as this in which a diffuse peritonitis was not found after death.' There are certainly cases where there are no signs of peritonitis present, but it remains to be proved whether in these cases there was an absence of peritoneal infection.*

Malcolm and others point out that an important factor in the causation of pseudo-ileus is the adhesion of the bowel to a small area, and this allows the bowel to kink, and the same train of events follow as if the bowel were entirely obstructed. We believe in these cases that the following experiment may help to throw some light on such cases:

If the splanchnic nerves be intact, the application of a stimulus

* We were once called upon to perform a section on a child aged five years, who had suffered from infantile paralysis for some years. The child had all the symptoms of acute intestinal obstruction, and these symptoms had been present for two days. We opened the abdomen, withdrew a coil of distended intestine and sewed it to the parietal wound, then opened it and drained it. The patient died twenty-four hours later, and we held an autopsy. With the exception of a little fluid in the stomach there was absolutely nothing in the whole intestinal canal, which was immensely distended with gas. There was no obstruction, no bands, and no signs whatever of any peritonitis.

We have been present at an autopsy of a woman who died after hysterectomy, and who had vomited continually for several days after the operation. She was very distended for some days before death, but there was absolutely no signs of peritonitis present.

Ramsay (*American Journal of Obstetrics*, July, 1899), in reporting two cases of death from pseudo-ileus that occurred in the Johns Hopkins Hospital, says: 'Following the operation we found it impossible to get the bowels moved with the usual treatment, the abdomen became steadily more distended, and the patient slowly sank, and died on the fifth day. There was no rise in the temperature and pulse until a few hours before death, and the only find at autopsy was a tremendous distension of the intestines, with no sign of occlusion, and a slight beginning peritonitis. The second was of exactly the same kind, and followed an abdominal panhysterectomy for carcinoma of the uterus.'

to any point in the intestine will cause a constriction at the spot excited, with—and this is an important point—a simultaneous reflex inhibition of the spontaneous contractions and tonus of all other parts of the small intestine (Starling).

An injury originating in one spot of the bowel may have far-reaching effects on other parts, for each segment of the intestines is subject to augmentation and inhibitory influences, partly originating in other portions of the gut, and transmitted along the walls of the intestine, partly originating in the intestine or elsewhere, and transmitted reflexly through the central nervous system (Starling).

We firmly believe that if even a small annular section of the intestine loses its contractibility, it is capable of acting as a complete obstruction to the passage of its contents, and so an ileus or a pseudo-ileus may be produced. Others stoutly deny this, and Treves says 'that it has never been shown that complete paralysis of a segment of bowel can alone lead to symptoms of acute intestinal obstruction.' We maintain that since true peristaltic contraction is a co-ordinated reflex carried out by the local nerve centres in the wall of the gut, the paralysis of a segment of gut will prevent these two events—augmentation of contraction above and inhibition of contraction below—which is necessary before any object in this bowel can be moved, and consequently such a condition is quite capable of leading to overdistension of the bowel with gas, because it cannot be moved down the intestines.

Treatment.—Prophylactic treatment will embrace, among other things, the preparing of the bowels before operations, and we have dealt with this subject at length in another chapter.

During the course of the operation we must take all those precautions which we adopt in our endeavours to prevent shock, and by preventing shock we prevent that series of changes in the circulation in the splanchnic area which we believe helps to lead to tympanitic distension of the bowel. We agree with Walthard that the serosa at the site of operation should be kept moist and glistening by being covered with gauze moistened in hot saline solution, and we believe that tympanites disappears sooner with a moist than with a dry aseptic technique.

With regard to the actual treatment of the tympanites, the measures recommended in the section devoted to the manage-

ment of the bowels are those that are to be followed in the first instance.

We may here, however, pause to ask how it is that purgatives cause such a wonderful change in the patient's condition in this complication.

Liebig first showed that the aperient salts cause a transudation out of the blood into the intestines. Thiry, Schiff, Radziejewski, and Schmiedeberg did not receive his explanation with favour.

Lauder Brunton, however, following in the footsteps of Moreau and Velpeau, carried out a number of experiments that convinced him that croton oil, elaterin, gamboge, and sulphate of magnesia all cause a copious secretion from the intestines, and that the greatest secretion was caused by sulphate of magnesia. All these substances accelerate peristaltic movements, and produce a decided secretion of fluid from the intestines, and thus a large quantity of fluid is drained away from the blood into the intestines; and some of his experiments showed that from 42 to 56 minims was secreted per square inch of intestine.

Now, it is to be noted that whatever theoretical views may be held on the action of purgatives in the treatment of tympanites, saline aperients appear to be most in favour, because the results are more uniformly satisfactory with these aperients.

We believe the favourable action of aperients can be thus explained.

Peristalsis can occur when the splanchnics are cut or the bowel is removed from the body, but when Auerbach's plexus is paralyzed and the muscles left intact, the power of the intestine to move its contents in any definite direction is lost. We hold that the bowel muscle of any segment of intestine is maintained in a state of tone by the tension of the gases or fluids within the bowel, and that Auerbach's plexus increases the excitability of the bowel muscle to the stimulus of the contained gas and fluids. If, however, Auerbach's plexus fails to act through alteration in the blood-supply—this alteration being brought about in section cases, in the first instance, through irritation and exhaustion of the splanchnics — then the bowel walls are dilated by the contained gases, because the tonic condition of excitability to internal tension which is maintained by Auerbach's plexus is abolished.

Now, it is well known that if the vaso-constrictor nerves

supplying a vessel be destroyed, the vessels after a period regain their tone; the tone is not, indeed, abolished completely, even for a time, as a local dilatation can be produced by irritants. So with the abdominal vessels that we are dealing with, they after a time tend to regain their tone, and the circulation becomes restored. If, however, the bowel is much distended with gas, this restoration of tone is delayed, as the mere distension of the bowel absolutely alters and impedes this circulation in the segment of the bowel distended. It does not seem, then, at all improbable to suppose that the great amelioration produced by saline purgatives is due to the power that these drugs have of altering the condition of the circulation, and by that means restoring the action of Auerbach's plexus, which is not exhausted, but its functions have been merely kept in abeyance by the altered condition of the circulation.

Whether this explanation be the correct one or not, certain it is that those surgeons who begin to administer saline purgatives quite early in the after-treatment have much less trouble with tympanites than those who leave the bowels alone for the first two or three days.

Turning now from theory to practice, we find that during the first twelve hours after the section the meteorism is never very marked, and causes little annoyance, but after this period the patient usually suffers some inconvenience and often great pain from the colicky pains and the distress of being unable to expel the flatus.

At every visit the surgeon should make a point of examining the abdomen, though he need not remove the dressing to do so. Usually the epigastric region gives us some idea of the amount of distension, but too much reliance must not be placed on this superficial examination of a small area. It is the surgeon's duty to satisfy himself from time to time that the abdomen is not becoming overdistended, and whenever he is in doubt the binders and dressing should be removed in order that he may inspect and percuss the abdomen. For, as Christopher Martin says, 'the hardness or softness of the abdomen to the touch is of far greater importance than the mere amount of distension. If the abdomen is soft and yielding, and can be made to wobble under the hand, we need not be alarmed. If it is hard, fixed, and tense, the outlook is grave.'

The first thing to be tried in giving the patient relief is the

introduction of the rectal tube. Generally the small bone or vulcanite nozzle of the enema syringe is employed. The objection to it is that there is a very small opening at the distal end, and this becomes easily blocked up. The best tube to employ is the distal 18 inches of a tube used for stomach lavage. This is composed of stout rubber, with a nicely rounded perforated extremity and an oval eye situated about ½ inch from the tip. When this has been oiled it may easily be introduced while the patient lies on her back.

If, however, we find that after introducing the tube for 2 or 3 inches that no flatus is expelled, then the patient should be turned on to her left side and placed in Sims' position. The nurse then introduces her right index-finger, well oiled, into the bowel, and slips the tube in with the left hand. By this means she is able to guide the tube up above the ampulla of the rectum, where it is allowed to remain for half an hour.

If, however, no wind passes, an enema of soap and water with turpentine may be injected by attaching the tube of the irrigator to the rectal tube.

If this fails we may then try 1 ounce of alum dissolved in a quart of warm water, and this often proves most effectual, or we may fall back on the quinine enema, 10 grains being given in 1 ounce of whisky with 4 ounces of water; this may be repeated in four hours' time.

Small injections of glycerine given every half-hour act very well at times, or we may give 1 ounce of sulphate of magnesia, with 2 ounces of glycerine, ½ ounce of turpentine, and 4 ounces of warm water.

Six drachms of tincture of asafœtida in 8 ounces of water is often very effectual. Enemata of peppermint water or of fennel water occasionally act well.*

Very large enemata of warm water may be tried from time to time. The patient is placed on her back, the pelvis is raised on a small pillow, the left hip being somewhat higher than the right, and the whole body inclined a little over to the right side. The nurse stands on the left side of the patient. A long tube is passed for 12 to 20 inches into the bowel by guiding it with the left index-finger, while it is pushed first to the back, then to the

* Some surgeons place one or more ice-bags on the abdomen. These often serve to stimulate peristalsis, and thus favour the expulsion of the flatus (Deaver, 'Appendicitis,' p. 258).

left, and then to the front. No force is to be used, and the tube must be withdrawn a little when any resistance is encountered; and such we often meet at the upper part of the ampulla of the rectum, where the folds of the mucous membrane—the sphincter of O'Beirne—is situated.

The water is now allowed to flow slowly in from a reservoir placed only a foot or so above the level of the patient, and this height may be gradually increased, but the whole success of the operation depends upon the water being injected slowly and without force. It is found that from 4 to 6 litres may be injected by this method if the parts about the anus are well compressed by the fingers during the injection, so as to prevent the reflux and the expulsion of liquid which takes place as soon as the tube is withdrawn, the expulsion being accompanied by the escape of large quantities of gas.

During the time that we are persevering with these enemata, we must not neglect to administer purgatives by the mouth, and we may try magnesia, calomel, croton oil, and elaterium.

Hypodermic injections of strychnine may be given when the contractions are weak; but when the bowel is making useless efforts to overcome some apparent obstruction, morphine ($\frac{1}{8}$ grain) will sometimes prove very effectual, and atropine also acts well. Both drugs evidently give the bowel a rest, and relieve the spasm which is preventing the proper peristaltic movements.

If the stomach is very distended, we should endeavour to get the patient to belch the wind up, and this she will do with ease if turned well over on her left side.

With regard to drugs, bismuth salicylate, benzol-naphthol, and salol given in a capsule often give great relief.

Half a drachm of 'Oxley's ginger' in half a wineglassful of water is of service, while Kelly praises Hofmann's anodyne given in a dose of 20 minims with some cracked ice. Five drops of turpentine on sugar, or a few drops of tincture of nux vomica in a teaspoonful of hot pepper tea, is said to give relief.

If, in spite of all our efforts, we fail to give relief, we must begin to suspect that the distension is a symptom of obstruction of the bowel, or of peritonitis, and we must use every effort to obtain an action of the bowels.

While we are considering what course we shall pursue, we may place on the patient's abdomen some flannels wrung out of hot water, to which a few tablespoonfuls of turpentine have been

added, and these may be renewed from time to time. If, however, they are continued for more than two or three hours, the skin becomes very hyperæmic and tender. It is therefore a good plan to stop the turpentine stupes after a few hours, and to cover the abdomen with a piece of lint which has been well smeared with a thick layer of green soap ; this has often a most sedative effect on abdominal pain.

Howard Kelly says that one of the best remedies for a distressing tympany is the light application of the Paquelin cautery ; the platinum tip, being heated to dull redness, is lightly drawn over the abdomen, only touching the top of the short hairs, and not actually coming in contact with the epidermis. When the entire abdomen has been gone over in this way, the patient is usually greatly relieved, and begins to pass great volumes of flatus.

If the Paquelin cautery is not at hand, a lighted wax taper may be used, and we have found, by beginning at the cæcum and slowly following up the ascending colon, and then going across to the descending colon and following it down, that the effect is sometimes excellent; the heat can be felt by the patient to penetrate through the walls of the abdomen, and this excites peristalsis. The effect on peristalsis of the burning taper or of the hot cautery is also greatly aided by the fear excited in the patient that she is about to be burnt.

In some extreme cases of distension the patients are placed in the knee-breast position ; then the rectal tube is introduced, and generally with good effect.

In one case Jenks stood the patient on her head, whereupon a large amount of gas escaped.

Treatment of Pseudo-Ileus.

If the distension has now become extreme, we are either face to face with an ileus, a pseudo-ileus, or with peritonitis, and we must therefore be prepared to reopen the abdomen. Before, however, we resort to this extreme measure we should try the effect of electricity, and in some cases of puncture of the intestines.

In a case related by Spencer Wells the left lung was completely compressed by the distended stomach, and faradization was tried for half an hour, and very large quantities of flatus were expelled

under its influence. This was repeated from day to day, and the tympanites became greatly diminished.

The success that has attended the treatment of ileus paralyticus by electricity makes it almost imperative that this treatment should be tried before proceeding to open the abdomen.

Lejars says that in 150 cases Boudet of Paris was successful in 70 per cent., and Larat has been successful 101 times in 130 cases. Being struck by the success achieved by Boudet, Lejars gave 'le lavement électrique' an extended trial, and he has been able to record many successful results.*

The apparatus required is a continuous current battery capable of giving a current of 50 milliampères; a large flat metal plate covered with chamois leather; a tunnelled rectal electrode, consisting of a metal rod enclosed in a gum elastic sound, which is pierced at the distal extremity, and connected at the proximal end by a lateral arm to a rubber tube, which is in turn connected with a graduated reservoir filled with salt solution.

The patient lies on her back, and the metal plate covered with chamois or cotton-wool and damped with salt solution is connected to the negative pole of the battery, and then laid on the abdomen.

The rectal electrode is connected with the positive pole, and is then inserted into the rectum, and is gently guided up the rectum as far as possible.

The patient may now be placed on a bed-slipper.

At first no electric current is allowed to flow, but the water from the reservoir is permitted to slowly enter the bowel, a pint or so being at first introduced, and as the bowel becomes tolerant of this amount more is allowed to flow in.

The water protects the mucous membrane of the bowel and isolates it from contact with the electrode, and at the same time it causes a wide diffusion of the electric current, and so becomes a kind of diffused liquid electrode.

The current is now turned on, but the galvanometer should at first not register more than 10 milliampères; but we may slowly increase the current up to 35 or 40 milliampères.

The abdominal electrode is changed from place to place every four or five minutes and the current reversed, care being taken always to bring the galvanometer to zero whilst reversing the current, otherwise the patient will receive a very severe shock.

* Lejars, 'Chirurgie d'Urgence,' p. 399.

After a time the desire to defæcate is felt, and intestinal waves may be perceived through the abdominal walls, and the salt solution injected into the rectum is violently expelled. When this occurs, the electric current may be shut off, and a fresh quantity of salt may be allowed to slowly run into the bowel.

The operation is continued for fifteen to twenty minutes, by which time the gas is often escaping quite violently from the bowel with the saline.

The whole operation may be repeated again in three or four hours when the patient has rested.

Operative Treatment of Tympanites and Pseudo-Ileus.

The operative treatment of excessive tympanitic distension resolves itself into puncturing the distended gut by means of a fine trocar passed through the abdominal walls, or of puncturing the intestine after exposing the various distended coils through an incision in the parietes.

All surgeons have observed the immediate change that takes place in a patient suffering from tympanitic distension when the bowels have acted; but it is also evident that even if the bowels do not act, and only flatus be freely expelled, the patient is much relieved. It has, therefore, occurred to many operators that relief by simple puncture might be of benefit in these cases.

We are indebted to Ogle* for having collected from such men as Spencer Wells, T. Smith, Oliver, Paget, Clifford Allbutt, Jenner, Tait, Ringer, Pye-Smith, Wilks, and many others, their opinions on this procedure; and he concluded from the evidence before him that there was sufficient to show that great good may be accomplished by this expedient, and that it is incontestably, when resorted to with circumspection and deliberation, a legitimate procedure attended by most benign results.

Tait said of the procedure that he has tapped intestines for the relief of overdistension in many instances, and he believed that in fatal cases of peritonitis that it gives relief, and he had obtained in 'severe cases such extension of time as to be enabled to pull the patient round the corner with safety.'

An examination of Ogle's evidence shows us that while some surgeons have had most satisfactory results from puncture of

* 'The Relief of Tympanites by Puncture of the Abdomen,' London, 1888.

the bowel, others have failed entirely. Thus, Clay tried it frequently after ovariotomy, and Allingham and Greig Smith have tried it on many occasions, and they all agree that it is useless. On the other hand, among the cases collected by Ogle there are some striking instances of relief and amelioration. Thus Sir James Paget relates the following case:

The patient was between sixty and seventy years of age and very feeble. After many days of complete obstruction or inaction of the bowels she became distended to the utmost. 'She appeared to be dying, and I had no hope of doing more than relieve her distress by puncturing the intestines at the tensest place. I did this with a small trocar and cannula near each ilium and at the upper part of the abdomen. Air escaped in large quantities, and the abdominal wall sank down. Some weeks afterwards I heard that the patient was in comfort, and that her bowels were acting.'

Ogle makes the following remarks (p. 46): 'In 1884 Dr. Hunter brought before the Obstetrical Society of New York a case in which, following peritonitis, tympanites was so urgent that the patient appeared moribund. The use of the long rectal tube proved insufficient for relief, and the abdomen was punctured by a long hypodermic needle, when gas escaped, and continued to do so for half an hour. The patient recovered.'

With regard to the after-effects, Ogle's cases show that many of them were followed by no serious after-effects, but in some cases the autopsy revealed the fact that some liquid fæces had exuded through the punctured holes, and this result was observed in the following case: The abdomen was opened, and the intestine punctured with a trocar and cannula, and it was 'noticed that the track of the puncture remained open for a few minutes in each case, and emitted air and feculent fluid, though I took care to introduce the instrument obliquely and valvularly.'

After carefully considering the evidence brought forward by Ogle and others, we think that it may be readily granted that puncturing the intestine will at times allow of the escape of large quantities of gas; and there is abundant evidence to show that, after puncturing a distended intestine, at times an escape of a small quantity of liquid fæces into the peritoneal cavity occurs.

This being the case, it appears to us that there is little to urge against the practice on the score of danger, especially when we know that 'a case of intestinal obstruction of sixteen weeks

duration is reported in which the abdomen was punctured 150 times.'*

We must remember that we are dealing with a condition that is always grave and often desperate, and, unless relief be given, death is almost inevitable. To urge that the escape of a little fæces will make the patient's condition more serious is to forget the fact that the fæces have little to do with the result, the danger lies in the bacteria contained in the fæces; and if we are to trust our present knowledge, we must admit that as the bowels are becoming paralyzed the germs are already making their way through the intestinal walls, therefore a few more in the peritoneal cavity will have little influence on the ultimate result.

The objection that has most weight with us is the inability of the trocar to empty the bowel sufficiently of air, and its utter inability to empty it of its poisonous contents. The bowel cannot in many instances be emptied of its gaseous contents, from the fact that when the intestines are greatly distended with gas there will be found in their course numerous kinks, and when a kink occurs there is formed an infolded valve. When, therefore, we aspirate the bowel, we draw off only the gas that is contained in the length of intestine lying between two kinks.

Again, if we observe those cases in which we have an artificial anus in the small intestine, we shall soon see that, although we may have quite a large opening in the bowel, no gas will escape through the opening for hours at a time, although the intestines may be quite distended with gas. If, however, we take a piece of rubber tubing and push it along in the lumen of the bowel, and begin to work it to and fro like a piston, we shall frequently find that there is a sudden escape of gas followed by an escape of fæces. What really appears to occur when peritonitis is present is that the fæces and the intestinal secretions of the small intestine become less fluid and more adhesive, so that the gaseous contents of the bowel find an increased resistance to their onward movement. This appears to us to be one of the chief reasons why aspiration by means of a needle fails. The gas contained in the bowel in the immediate neighbourhood of the needle escapes, but the gum-like fæces prevent the gas from the segments of the bowel above and below the seat of puncture from rushing to fill the segment emptied by the needle.

* Treves, 'Surgically Applied Anatomy,' p. 330, 1901.

All things being considered, we think that puncturing the bowel with a fine trocar is a measure that may be given a trial in cases of extreme tympanites. We would suggest that the puncture should be made in the region of the cæcum, for here a small extravasation of fæces will be well borne by the peritoneum, and by exhausting the gas from the ascending colon we may possibly induce the inflow of gas from the small intestine.

It must, however, be borne in mind that if the results are not immediately striking that we should not hesitate to proceed to open the abdomen, draw out the first distended coil of intestine met with, and either puncture it with a large trocar, or make a small incision in it and in as many coils as may be necessary.

This is done in the following way: If there is great distension of the intestines, and obstipation has existed, the distended coils should be incised at points opposite the mesentery, dragging each loop out of the abdomen, and protecting the rest of the wound from contamination with the help of gauze packings. This part of the operation may be facilitated by turning the patient somewhat upon her side, and holding a pus basin, covered with a sterile towel, so that the intestinal contents shall run into it. In opening the gut, the narrow-bladed knife is used, and the openings should not be more than $\frac{1}{8}$ inch in length, running parallel with the axis of the intestine. The coil which is being manipulated should be carefully held in place, so that it may not slip back into the abdomen before the opening shall have been sutured. Each incision should be closed with three or four fine silk stitches, and after testing the water-tight quality of the little suture line by gently milking the intestine towards it from both sides, and ascertaining that no leak exists, this coil may be returned into the abdomen, and the next distended loop treated in a similar manner. It sometimes happens that, having plunged the narrow knife into the intestinal lumen, no fluid escapes, on account of the pouting of the mucous membrane into the wound. If the scalpel or a flat probe held in the wound is turned at right angles to it so as to separate its edges, the coil will rapidly empty itself. A sufficient number of incisions should be made to relieve the tension in a large portion, or in all of the intestine, leaving it quite flaccid. The colour of the intestinal wall will be found to improve at once, and if the case has not gone too far, contractions will occur

on irritating or bluntly pinching the bowel, showing that true paresis is absent.*

Some operators, instead of opening the abdomen through the middle line, prefer to make an incision over the cæcum, because, as Harrison Cripps says, 'in the first place the intestine will probably not be opened so high up as would be the case if exposed in the middle line, while in the second the long primary incision can be well protected from fæcal contamination from the new wound.' Cripps adopted this plan in four cases with three recoveries. He makes an incision in the region of the cæcum. 'A portion of the tightly distended intestines will at once present itself in the wound. By means of a fine curved needle the parietal peritoneum is stitched round the distended bowel so as to leave an area of its surface about the size of a threepenny piece exposed, great care being taken that the needle passes no deeper than the muscular coat of the bowel. When the peritoneal cavity is thus completely shut off, the exposed area is perforated by a small scalpel. A certain amount of wind and fæcal material immediately escapes with a splutter. The operator must not expect the abdomen to collapse like a pricked balloon. All that comes out at first is gas, etc., that lies in the small segment of the particular portion of the bowel opened. In the course of the next few hours, however, the distended bowel will gradually relieve itself by fits and starts. A glass or an indiarubber tube can be so arranged with a little ingenuity so as to fit accurately into the open bowel, and being taken through the dressings will prevent the immediate soiling of the wound. Such a tube requires much attention, otherwise it will become blocked by the pressure of the mucous membrane of the opposite side of the bowel against its orifice.'

As we do not desire a fistula, the opening into the large or small intestine should be made longitudinally, so that it will close spontaneously in a few days.

Van Arsdale has recorded some cases in which he performed enterostomy for intestinal paralysis, but the tympanites did not become less; accordingly 'a catheter was passed into the intestine, and irrigation with salt solution was employed, which was followed by a copious discharge of gas and fæcal fluid matters which continued into the dressings, much to the relief of the patient.'

* Lilienthal, 'Imperative Surgery,' p. 300.

In one of our own cases, when during the course of a section we found very extensive malignant disease of the middle part of the rectum, we fixed the sigmoid into the median wound. Two days later the patient was enormously distended with flatus. She had no temperature, but her pulse was very rapid. We accordingly opened the bowel and introduced a long rubber tube. Immediately the gas began to escape, and the distension disappeared after a few hours, and her pulse fell to normal.

In another case where, after operating on a gall-bladder complicated with malignant disease, we found that at the end of forty-eight hours the patient's temperature was normal, but her pulse was 170, and there was extreme tympanites, we made an incision in the right semilunar line on a level with the umbilicus. A coil of small intestine, very congested and distended, was withdrawn and allowed to hang out of the wound. A pair of forceps was pushed through the mesentery, and the bowel was fixed to the parietes with a few safety-pins. An opening in the bowel allowed of the escape of gas and a little liquid fæces. To encourage the escape of both, a piece of rubber tubing was introduced into the bowel for 12 inches, and sulphate of magnesia, glycerine, and cascara were injected from time to time. The improvement in the pulse was very marked. When the patient's condition improved, calomel in small doses was administered by the mouth, so that the stomach and duodenum became emptied at the artificial anus, while the injections of croton oil and cascara through the artificial anus caused the bowels to act freely by way of the rectum.

CHAPTER XXXVII

SEPTIC INTOXICATION—SEPTICÆMIA—PELVIC ABSCESS—PYÆMIA

Septic Intoxication.

From time to time after removing pus-tubes, or after opening a pelvic abscess, we find, during the first twenty-four hours following the operation, that the temperature rises rapidly to 103° to 104° F., and the pulse-rate increases to 140. During the next twenty-four hours the pulse and temperature rapidly fall, and the patient progresses favourably.

Many of these cases are instances of septic intoxication, the disturbance witnessed having been due to the absorption of toxins which have been manufactured, and have accumulated in a confined space, and which are now liberated and are absorbed because the lymph spaces have been opened during the course of the operation.

When we operate on cases where we have an intraperitoneal rupture of a gravid tube, and the blood-clot has been in the peritoneal cavity for a week or more, we frequently get a considerable rise in the temperature and pulse-rate after the operation, and this elevation continues for three or four days after the operation. The rise is too high and too prolonged to be due to 'fermentation fever'; it is probably caused by the absorption of toxins, which have been formed in the blood-clot by the action of organisms which have found their way into the peritoneal cavity from the bowel. The cleansing of Douglas's pouch and the sponging away of adherent blood-clot open up channels for absorption, which goes on for some days after the completion of the operation. This is especially noticeable in cases where the parts are sponged with peroxide of hydrogen, on account of its solvent action on the blood-clot. In other instances,

when the case goes on satisfactorily at first, we may get septic intoxication if a septic focus occurs, at which toxins are continually elaborated and then absorbed.

We must also bear in mind that we may get all the symptoms of sapræmia in a case of intestinal obstruction, the poison in this instance being absorbed from the bowel—*i.e.*, auto-intoxication. Some observers go so far as to maintain that this absorption of noxious fluids from the bowel is quite common after sections where there has been any considerable loss of blood, the fluids being absorbed to make up for the loss of fluid from the blood and tissues.

Symptoms.—When during the first twenty-four hours after a section we find the temperature quickly rising, the pulse growing more rapid hour after hour, the tongue becoming dry and glazed, the skin hot and the patient flushed, the urine scanty and high-coloured, we hope that the cause may be septic intoxication, but we are always extremely anxious lest we are about to be brought face to face with acute septicæmia.

We have twice seen this rise in temperature and pulse-rate lately.* In the first instance the patient had all the symptoms of ruptured ectopic pregnancy, but when the abdomen was opened it was found that she was suffering from a double pyosalpinx. In removing one of the tubes some of the pus escaped. Twenty-four hours after the operation the pulse-rate was 160, and the temperature 102·2° F. After removing some iodoform gauze that was in the pelvis, and opening the bowels, the pulse and temperature both fell, and the patient made an uninterrupted recovery.

The second case occurred in the practice of a colleague. He operated on a case of tubal mole. The temperature and pulse rose. The patient's tongue became glazed and dry, the face red, and she was intensely thirsty. The pulse and temperature fell in this case in the same manner as in the first, and the patient recovered.

In cases where a small collection of pus forms after an operation, as we get in connection with the abdominal wound, the symptoms of the slow absorption of the toxins may be very slight. The pulse is only increased slightly, and the patient complains of nothing. A week or ten days may elapse before

* We are in some doubt as to the real interpretation of the rise in the temperature and pulse in these cases.

the gradual rise of the temperature at night-time is sufficient to cause us anxiety.

This gradual rise is well seen in the chart (Fig. 120), where suppuration was due to the catgut used in sewing the aponeurosis of the rectus after an operation for ventral hernia. The chart shows the immediate disappearance of the fever on the evacuation of the pus.

In other cases the symptoms are much more severe and striking, and we shall be unable to differentiate clinically between septic intoxication and septicæmia. An examination of the blood discloses the fact that in septic intoxication we have no micro-organisms present; unfortunately, a negative examination does not exclude septicæmia.

Prognosis.—If the symptoms are due to the sudden liberation of a quantity of toxin, the patient may be overpowered and poisoned in a short time. This is only likely to occur in the debilitated, and in those whose excretory organs are impaired. If, however, the amount of toxin is not excessive the organism will survive, because these toxins are rapidly excreted, and the patient tends to recover immediately.

When, however, the toxins are derived from a focus which continues to be a laboratory for these poisons, the prognosis will depend upon our power to successfully deal with the focus in question.

Watson Cheyne says that he believes that sapræmia is not uncommon in operations on the peritoneum, and that a good many of the cases of death from exhaustion, and of those cases where there has been fever but no peritonitis, are really cases of sapræmia due to the introduction of non-pathogenitic saprophytic organisms into the peritoneal cavity. He thinks that certain symptoms of 'collapse' or 'shock' on or about the third day after operation are commonly due to sapræmia, and it is probable that large numbers of deaths after ovariotomy and other operations on the abdomen, which have been ascribed to shock and exhaustion, are really due to sapræmia.

Treatment.—These cases of septic intoxication, which are due to the absorption of a suddenly liberated dose of toxic material, require to be treated on the same lines as if they were cases of shock, especially if they show signs of collapse. Ammonium carbonate and strychnine may be given, and submammary injections of saline solution may be tried so that the poison may be attenuated and eliminated by the kidneys.

The skin should be got to work efficiently, and the bowels should be opened freely.

In those cases where the septic intoxication takes place gradually, we must endeavour to ascertain the focus at which the chemical poison is being manufactured, for we cannot hope that the febrile symptoms will subside until the entire quantity of resorbable material has been removed. We shall therefore consider these cases in dealing with septicæmia and pelvic abscess.

Septicæmia.

Etiology.—In **septic intoxication** we saw that the blood might receive the suddenly liberated toxins set free on opening an abscess cavity, and the signs and symptoms might develop during the first twenty-four hours, no incubation being required; while, on the other hand, the intoxication might be an after-event when it was due to absorption from foci originating after the operation.

In **septicæmia** we see the same course of events. We may at the time of the operation infect the patient with organisms that are so virulent that the incubation period is but a few hours, and all the symptoms develop shortly after the infection, and the patient rapidly expires. In these cases of **primary acute septicæmia** the wound, or the pedicle, being the seat of the trouble, the bacteria pass immediately into the circulation either by way of the lymphatics, or perhaps by the capillary vessels, the effect being produced not only by the mechanical presence of the organisms, but also by the action of the toxins, the metabolic products of these organisms.

In other instances the symptoms do not develop so rapidly, the incubation period being extended over days. At first we may have mild symptoms, interpreted rightly as septic intoxication or fermentation fever, but these give way to a **sub-acute primary septicæmia** on the third or fourth day.

In a third class of cases the symptoms are only gradually evolved, and may not be noticed for a week or more after the operation, when the organisms, which have probably infected the body after the operation, and are located in an abscess cavity or septic focus, make their presence known by an intoxication, or by an intoxication aided by a mechanical interference. Such cases may be grouped under the heading of **secondary septicæmia.**

Instances of acute septicæmia are not common at the present day, though the histories found in the note-books of Wells, Baker Brown, and the earlier ovariotomists show that many of the deaths from 'collapse' were in reality deaths from acute septicæmia. As the hands and the instruments were the cause of these fulminating cases in the past, so also when they occur now the surgeon generally inoculates his patient at the operation, and sees her dying collapsed with a rapidity that allows no time for treatment, even if any could be of any avail.

Tait has recorded this awful finale to some of his cases. He says: 'Some years ago I opened the abdomen of a woman, four days after her labour, for purulent peritonitis. . . . On the third and fourth days after I operated on two simple ovarian tumour cases, and the rapidity with which these two women succumbed was altogether shocking, the post-mortem examination leaving no other guess than acute septicæmia.'

Secondary septicæmia is most usually due to an intramural abscess caused by the suture track becoming infected, or it is still more frequently due to pelvic suppuration which occurs with the decomposition of fluid in Douglas's pouch, or when a hæmatocele suppurates in the broad ligament. Hydatid cysts and parovarian cysts, when operated on, become the sites for collection of pus, for in the former the ectocyst, being left behind, soon becomes infected by the micro-organisms from the air and from those situated between the ectocyst and endocyst; while in the latter the oozing, after the enucleation of the cyst, causes a hæmatocele to form, which becomes infected through the drainage-tube.

Many of the conditions that we shall note in connection with 'fæcal fistula and sinus' may be considered in connection with the etiology of septicæmia, and as an infected ligature is so often the cause of fistula, so infected ligatures account for many cases of septicæmia.

Symptoms.—The symptoms that a patient exhibits with primary acute septicæmia show themselves generally twelve to eighteen hours after the operation. The pulse is observed to increase rapidly to 130, and the temperature also rises; but it is to be noted that the temperature after the first small rise not infrequently falls or remains stationary, as though the organisms elaborated both a chemical body which raised the temperature and another which lowers it. The respirations are accelerated,

delirium followed by coma supervenes, the pulse becomes imperceptible, and the patient dies collapsed, as though she had been killed by an injection of mineral poison.

In most cases of primary septicæmia the infection is not so virulent as to kill the patient straight away; she grows gradually ill, and the symptoms are only fully developed after some days. The following is a good instance of this: Robb operated on a patient and performed a hystero-salpingo-oöphorectomy for a tubo-ovarian abscess involving the uterine cornu. Appendicectomy was also performed. 'The temperature at the time of her entrance ranged between 100° and 102° F., but for the most part was under 102° F. At the time of the operation we were not able to demonstrate any organisms by cover-slip examination in the pus that escaped. We accordingly followed our usual plan of washing out the abdomen and closing without drainage. In eight hours the patient's temperature rose to 104° F., and the pulse to 148. She was, however, feeling comfortable. The next day her temperature fell to 101·5° F., and her pulse to 128. For the succeeding twenty-four hours her symptoms were, on the whole, favourable, and, with the exception of some difficulty in respiration, she seemed to be progressing satisfactorily. Her temperature varied during the next three days between 101° and 103·8° F.; at the same time there was marked dyspnœa, and the pulse gradually increased in rapidity. She finally died on the fourth day following the operation without having shown any marked evidences of peritoneal involvement, as there was no nausea, vomiting, or tympany, and the bowels had been thoroughly opened. Autopsy showed the case to be one of pelvic abscess with general sepsis. Cultures made from the lung showed a pure *Streptococcus pyogenes* infection, the same organisms being also found in the liver, pleura, and peritoneum.'*

When a case develops secondary septicæmia, the patient may have gone on well for days, or weeks, after the operation. The temperature chart then begins to show evening rises and morning remissions, the evening temperature going gradually to 102° to 103·5° F. The pulse-rate increases to 120 to 135; the patient is often bathed in perspiration, and may have a rigor. The tongue becomes coated, the breath foul, and the bowels may be relaxed; the urine is scanty and highly coloured, sometimes with

* Robb, *American Journal of Obstetrics*, August, 1901.

albumin. In fact, the patient exhibits all the familiar signs of 'blood-poisoning,' which we need not further enumerate.

If the blood be examined it will show leucocytosis, the leucocytes being polynuclear, and the blood withdrawn from an arm-vein under aseptic precautions will in all probability show abundant bacteria.

Course and Results.—As stated above, primary acute septicæmia runs a rapid course, and ends in death within twenty-four or forty-eight hours. When, however, the infection is not so virulent, the patient, after developing alarming symptoms, may recover.

In secondary septicæmia the course will depend upon the seat of the trouble. If the septic focus is a pelvic abscess, then the patient may not exhibit alarming symptoms until the second week, and she may become gradually emaciated before the seat of the trouble is discovered. In one of Keith's cases, after a double ovariotomy, the patient felt well until the sixth day, when she had diarrhœa and abdominal pain; after waiting another week Keith evacuated, through a trocar, abscesses in different parts of the pelvis on the twelfth, fourteenth, and twenty-first days.

In some cases the patient's recovery may be delayed for many weeks. In one of Peaslee's cases where an abscess arose in the pelvis, from blood derived from the vessels divided in separating the omentum during an ovariotomy, the surgeon in his after-treatment made no less than 135 injections into the peritoneal cavity during seventy-eight days.

The following charts are from two cases of septicæmia.

The first case was a young woman, aged twenty-four years, with hydatid cyst of the liver, and a second one in the broad ligament. They were both treated according to Lindemann's method, the cyst-wall of the tumour situated in the broad ligament being sewn to an opening made in the posterior fornix of the vagina. Both cysts soon became septic, and the patient became rapidly exhausted and emaciated. On the ninth day after the operation, the nurse in charge of the case was able to remove some large sheets of calcareous tissue from the upper cyst, and after this the patient's temperature and pulse improved, and she recovered (Fig. 123).

The second case is that of a patient upon whom hysteromyomectomy was performed. The tumour mainly occupied the

cervix, the uterus being placed like a knob on the top of the tumour. In removing the tumour the vagina was cut through, but a portion of the cervix was allowed to remain. The peritoneum was sewn over the stump according to Pryor's method. The patient soon began to exhibit a temperature, and an increased pulse-rate. An examination of the tumour having shown that it was degenerating, it was deemed advisable to remove the stump of the cervix by a vaginal operation sixty hours after the first operation. This was done, and a little pus was evacuated. The patient appeared to improve, and the temperature and pulse fell; but the improvement did not continue, and the patient began to get emaciated and yellow. Some pus was evacuated from the lower part of the abdominal incision, and ultimately the abdomen was reopened and irrigated, but the patient expired. In this case the septic trouble arose from the germs in the degenerating tissue of the part of the tumour left behind with the cervix.

Twenty-four hours before the patient died one of her legs began to increase in size from thrombo-phlebitis, a complication not infrequent when pelvic suppuration complicates the after-treatment.

The third chart is from a case of **Pelvic Abscess** due to suppuration of an intraperitoneal hæmatocele (Fig. 121).

Pyæmia.

Should the septicæmia continue it may merge into **pyæmia.** Such a result is, fortunately, uncommon now. In one of Harrison Cripps's cases, where the operation was performed to remove suppurating ovaries, 'the drainage-tube was sucked out daily several times, a small quantity of thick, horribly offensive material being drawn off each time. She did fairly well for three weeks; she then had a severe rigor, followed by the formation of an abscess in the neighbourhood of the elbow-joint. . . . Six weeks after the operation she had another severe rigor, which was followed by the formation of a large abscess in the lumbar region.' The patient died of exhaustion five months after the original operation.

Wells records the following case, his fifty-ninth: We find him on the twelfth day aspirating Douglas's pouch and removing a pint of serum with blood and some pus, not at all fœtid. On the twenty-fourth day his notes say: 'Very low; pulse 140 to 160; copious perspiration, tympanites, cough, and mucous râles;

sordes on teeth; very drowsy; mucous diarrhœa; stools pass almost involuntarily; plenty of urine.' The patient died on the twenty-fifth day, and there was pleurisy on both sides, and at the bottom of Douglas's pouch there was a cavity containing 3 to 4 ounces of pus.

Diagnosis.—It is of importance to endeavour to differentiate between cases of shock, secondary hæmorrhage, and acute septicæmia, and with the latter we may combine fulminating peritonitis, which is a form of acute septicæmia.

In attempting to differentiate between these conditions, we must remember that in each shock plays such an important rôle that we may be absolutely unable to say whether we are face to face with a case of pure shock, or of shock and hæmorrhage, or of acute septic poisoning, which is one of the most profound forms of shock.

In all these conditions we gain much by watching the case for an hour or so; and as we employ practically the same treatment at the outset in each condition—*i.e.*, stimulation—we are aided by watching the effect of this treatment.

In pure shock the symptoms exist from the time the patient is placed in bed, and treatment tends to ameliorate this condition very much.

In secondary hæmorrhage the alarming symptoms set in any time during the first forty-eight hours, and the patient grows worse as the hours pass by in spite of treatment.

In septicæmia the patient shows no unusual symptoms until twelve hours at least have elapsed, unless we have—say from a tube or a gall-bladder—an accumulated supply of chemical poison which floods the system and produces a septic intoxication; with such a case we may have a meteoric rise in temperature in a very short space of time.

In each and all of these conditions the pulse is rapid.

In shock it is rapid from the time the patient leaves the table, but tends to become less so as the hours pass by.

In secondary hæmorrhage the pulse may jump suddenly from the normal, and increase 10 to 20 beats every half-hour, while in septicæmia the pulse begins to go up steadily after six or eight hours have elapsed, reaching 130 in a short time, its volume and tension being very different to the weak, failing pulse of hæmorrhage.

The temperature in shock is always low, and in secondary

hæmorrhage we have a fall if the hæmorrhage is excessive. In septicæmia we usually have a sharp rise, but we may soon have an actual fall.

The general appearance of the patient is always of great importance.

In shock and hæmorrhage we have the pinched look—the 'facies hippocratica.' The patient fights for her breath as she loses blood; she is restless, and wishes to sit up; her face is pale, her pupils dilated, and her lips and tongue lose their colour; and her forehead is cold and clammy.

In septicæmia the patient is often quite calm, even dazed; there is no air hunger; her blood-stream is sufficient; she may even be flushed, though in the most severe form her face is pinched and haggard.

The tongue in shock is clean, unfurred, cold, and often moist; in hæmorrhage it is cold and white; in septicæmia it is clean, dry, and glazed.

If we examine the blood in a case of shock in which but little blood was lost at the time of the operation, the blood-count may be high. With severe hæmorrhage the blood-count will be low, say 3,350,000 red cells with 35 per cent. of hæmoglobin. In acute septicæmia the leucocyte-count may be quite normal—not so in chronic cases—and the blood will contain streptococci, or other bacteria, in many cases.

Treatment.—The careful emptying of a pus sac by way of the vagina, by aspiration, is among the most valuable means at our disposal for preventing septicæmia. The remarks that we have made with regard to the prevention of peritonitis are equally applicable to this subject.

In cases of acute primary septicæmia all treatment is useless. We shall, as a matter of routine, give stimulants, and treat the patient as though she was suffering from shock, in the hope that our grave diagnosis may be incorrect.

The cases of septicæmia that offer the best field for treatment are those in which we are called upon to deal with localized collections of pus, either in the abdominal wall, or in the folds of the broad ligament, or in Douglas's pouch.

When the septicæmia is due to a suppurating, right-sided, broad ligament hæmatocele, this may be attacked from above; but if it be situated on the left side it is well to wait, for usually the pus will be discharged by way of the bowel.

If the collection points towards the vagina, it may be incised and drained by way of that passage.

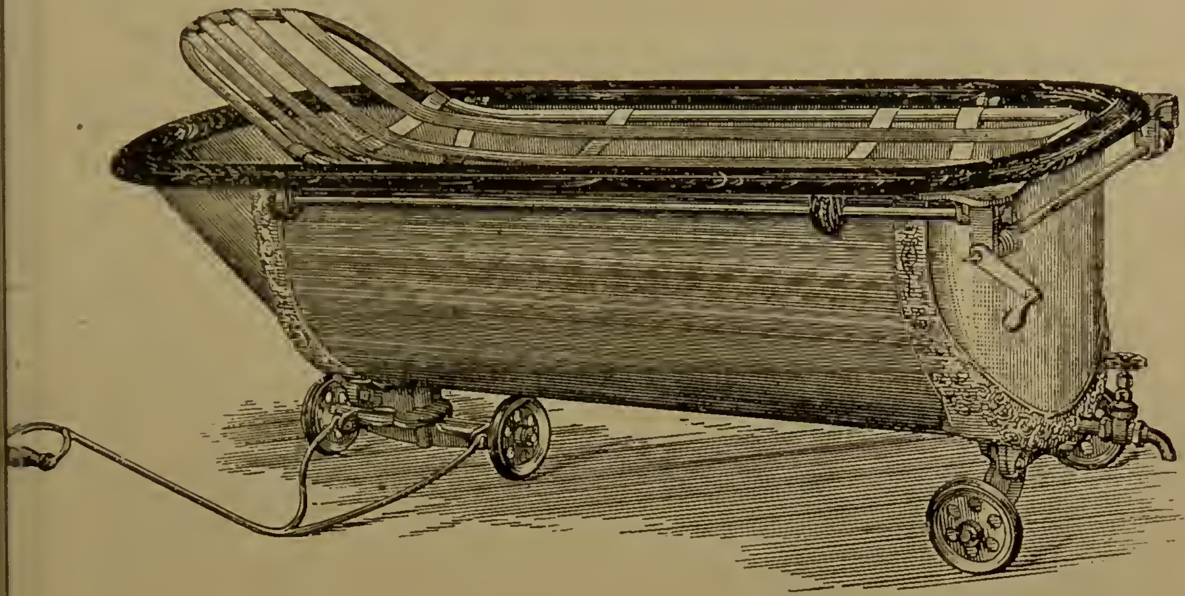

FIG. 128A.—A Bath which can be wheeled to the Bedside.

The peritoneal cavity can be well irrigated while the patient lies on the framework, or the patient may be immersed by lowering the framework into the bath beneath.

In cases when we are dealing with hydatid cysts, great benefit will be derived by placing the patient daily for an hour or so in a hot bath while we wash the cyst out by continuous irrigation.

CHAPTER XXXVIII

PERITONITIS

Peritonitis and shock are the two complications that are destined always to engage the mind of the surgeon after performing a section.

Peritonitis presents itself in two forms—*i.e.*, the **traumatic** and the **septic.**

Traumatic Peritonitis.

The most enthusiastic advocate for the germ theory must now admit that sufficient evidence has been collected to allow us to say that suppuration may occur without the presence of micro-organisms, while no one attempts to deny that inflammation may be due to many causes quite unconnected with germs; of these causes traumatism is the most common.

Definition of Peritonitis.—At the outset we must try to define peritonitis.*

If a simple section is performed, and if, after a few days, we have occasion to reopen the abdomen, we may find numerous adhesions between adjacent viscera; these adhesions are the signs of what is generally known as plastic or traumatic peritonitis.

Now, there are some who consider that such cases should not be classed as instances of peritonitis, for they look upon these adhesions as being merely the repair of injured tissues—in fact, merely as local conditions, and nothing more; they hold that true peritonitis is always due to infection, but that inflammation of tracts of the serous membrane is not to be regarded as peritonitis, but in many cases only as the repair of the injured tissues.

* Peritonitis. 'This termination "itis" is a feminine adjectival suffix, which has nothing to do with implying inflammation. Peritonitis means no more than peritoneal, disease being understood' (Gee).

If we grant this distinction, then we can see how it is that bacteriological examination of the repaired district may show no signs of micro-organisms, and we may get a condition known as 'traumatic peritonitis without germs'; in other words, a repair of the injured peritoneum by inflammation without the presence of germs—a mere process of healing, not a grave pathological condition.

Whether this contention be true or not, we have no difficulty in believing that no inflammation of the peritoneum can do much immediate harm if unaccompanied by germs. For instance, if we inject croton oil into the peritoneal cavity we get an exudation at first quite free from germs—that is, we get **an inflammation of the peritoneum**—and if the quantity of oil injected is not great, we get only a 'plastic peritonitis'—*i.e.*, **an inflammatory healing without germs.** But if the quantity of oil injected be increased, we get at first an exudation, and then all the signs of a true peritonitis. Why? Because the oil has damaged the serous coat of the intestines, and the peritoneum now becomes infected from the bowel, and the peritonitis that follows is due, **not** to the **oil,** but to the action of the **germs.**

It therefore follows that if after a section traumatic peritonitis occurs, it is to be regarded rather with favour, as it is a healing inflammation, although we must remember that the adhesions formed may ultimately cause ileus. But inasmuch as it is impossible to be certain that germs are absent from the seat of this supposed healing inflammation, it is much wiser to regard every case which exhibits signs of peritonitis as a case of true peritonitis—*i.e.*, peritonitis in the presence of micro-organisms.

It is obvious that this is the safest and most rational stand to take up, for the following reasons:

It seems impossible that we can manipulate, say for half an hour, in the peritoneal cavity and yet not leave infectious germs behind. We know that though our hands may be sterile at the outset that the perspiration forces septic germs out of the pores during the course of the operation, and that the longer the operation continues the more likely are the tissues to become infected. It is only in such simple operations as ventro-suspension, or the removal of a small ovarian cyst, when our hands are encased in rubber gloves, that we can hope to leave the peritoneal cavity practically with no infection. In more extensive opera-

tions we may be sure that we always get a traumatic peritonitis, which is an inflammation, and is the series of changes constituting the local manifestations of the attempt at repair of the actual injury to the peritoneum. The extent of this inflammation will be in proportion to the duration and to the amount of irritation, and the process is limited when regeneration gets the upper hand of degeneration; and it is possible that the negative bacterial results may be but a phase of the victory, and that a positive chemiotaxis has been the means of ridding the tissues of any germs that may have been present during the process, for the less virulent the microbes the more extensive is the phagocytosis.

On the other hand, when in addition to the traumatic inflammation we get a true peritonitis, then this condition is due to the fact that the tissues have been infected. If the germs present are few and not virulent, the clinical picture presented to us is no doubt one of 'traumatic peritonitis,' though it is in reality *more* than a *local inflammation;* but we cannot by our present methods distinguish between the two conditions at the outset.

If, however, the germs are present in quantity, and if they are virulent, or if the individual has a low resisting power, then the traumatic inflammation sinks into the background, for it is marked by the more important septic inflammation, with its local and systemic effects. Then the changes that we see in the peritoneal cavity in such cases represent the efforts made by the serous membrane to overcome the too powerful irritation caused by the presence of the micro-organism; 'it does not represent, as is too commonly assumed, the reckless and fanatical destruction wrought by a wholly evil-tending process' (Treves).

It is well to bear in mind that it is not true that death takes place only when the amount of destruction in the peritoneal cavity has attained to far-reaching bounds; on the contrary, in some forms of peritonitis death takes place with surprising rapidity, and yet an examination of the peritoneal cavity shows us few signs of any inflammation, while it is a well-known fact that those cases in which suppuration is most pronounced are the most favourable examples of peritonitis (Treves).

We must assume, then, that death from peritonitis is due to the absorption of the products from the peritoneal cavity manufactured by the micro-organisms, and it is the absorption of

these products that gives us the clinical picture familiar to us under the name of peritonitis.

It will follow from the above considerations that the after-treatment of peritonitis following a section must be both a local and a general one, and that the reason why we have failed so often to alleviate this condition is, that while we can do a certain amount for the local conditions, we can as yet do little to control the poison when once it has become absorbed into the system. This being so, it follows that we have fewer deaths now after cœliotomy from peritonitis, not because we have advanced much in the after-treatment, but because our prophylaxis is better.

Mild, Grave, and Fulminating Peritonitis.

In considering the symptoms of peritonitis we need not distinguish between traumatic and septic peritonitis. It is impossible to point to a group of symptoms, or signs, by which these forms at the outset can be readily distinguished, and, as we have already stated, we shall do well after a section to look upon any symptoms of peritonitis as indicative of infection.

But while we need not distinguish between the traumatic and septic varieties, we must for clinical purposes regard this complication according to its **severity**, and we accordingly distinguish three degrees, the **mild**, the **grave**, and the **fulminating**.

Mild Peritonitis.—When after a section that has occupied half an hour or more for its performance, and the organs removed contain no septic pus, though they may have been closely adherent to adjacent viscera, we not unfrequently find that on the following day the pulse-rate has increased to 100, and the temperature has risen to 100° F., while the abdomen has become slightly distended with flatus in the region of the umbilicus.

Twenty-four hours later, towards the evening of the third day, the distension has become more marked, the epigastrium being now visibly distended, and the patient complains much of not being able to pass the flatus, though she may be able to get rid of some gas from the stomach when she vomits from time to time. The pulse now is felt to have increased tension, to be somewhat bounding, and to range from 100 to 115, while the respirations are quick (26) and shallow. The tongue has a light-gray coat, and is dry, but the edges are red, and the tip is clean.

The patient complains of thirst, but if asked to spit into a dish she can get sufficient saliva to do so, but it is of a milky appearance, and rather viscid.

The vomited matter consists of the food she has taken, mixed with a little bile. Her mind is quite clear, her features are not pinched, but she looks worn and tired, and she tells you that she has had but little sleep.

Her chief complaint is about her thirst and her pains, and she expresses a wish to be relieved of the flatus.

She lies in bed with her legs drawn up, and she remains quite still; she has no inclination to be turned, and shrinks when the abdomen is percussed or palpated.

During the next two days she improves; the bowels can be got to act either by often repeated doses of magnesia or calomel, or after several enemata.

She now finds that she can pass flatus readily; the vomiting ceases, the tympanites diminishes, and the pulse and temperature gradually creep back to normal, and by the fifth or sixth day after the operation the patient is ready for her meals.

Such is the picture that not unfrequently presents itself to the surgeon after the most carefully performed section, and these signs and symptoms may be interpreted as those of traumatic peritonitis or of mild septic peritonitis; but the differential diagnosis will not be founded on any substantial basis.

Grave Peritonitis.—The picture that we have given of the mild form of peritonitis is, in some cases, the forerunner of this second and grave condition; but usually when the peritonitis is going to be severe all the signs are intensified after the first thirty or forty hours. We do not have the mild form going on day after day gaining in intensity, and then merging into the grave form after a week or ten days; on the contrary, time is a favourable factor in peritonitis, and once a case has lasted seven days the prognosis is favourable.

The onset of grave peritonitis after a section is not marked by a rigor. For the first twenty-four hours the temperature may be normal, or even subnormal if the operation has been a severe and prolonged one, and the pulse-rate may be rapid from the outset owing to shock; but on the morning after the operation the pulse frequently becomes steadier and the temperature rises a degree or two, and the patient looks better.

Soon after noon on the second day, or as the evening

approaches, the pulse begins to show signs of the coming storm. A finger placed on the radial vessel will immediately detect no longer the small, weak, compressible pulse of shock; it is now long and hard, and it may be noticed that between the beats the artery is full (unless the case is still overshadowed by shock), and it requires some force to compress it, while it numbers from 100 to 115 pulsations per minute.

It will now be noticed that the patient's face is flushed, but it is only during the early stages of peritonitis that we get this sign, for as the case advances in severity, and the temperature rises, the face, instead of remaining flushed, becomes a pale lemon tint and drawn.

As the evening closes in the temperature will rise (100° to 101° F.) and the pulse increases (120), and the vomiting, which has occurred at intervals during the day, now occurs whenever she takes a sip of fluid to relieve the thirst which has troubled her from the onset. Vomiting also occurs now whenever a nutrient enema is given, and the patient begins to dread these rectal injections.

As the night wears on the flatus gives her no rest, and if the binder and dressings are removed it will be seen that her abdomen is slightly distended, and if we kneel by the bed and follow the outline of the abdomen, we find that it is no longer flat or concave; it is now convex, and the highest point of the curve is about the umbilicus, and from there it slopes rapidly towards the epigastrium—where there may be a second smaller rise due to the distended stomach—while it slopes more gradually towards the pubes; the regions, however, about the colon are not at this period distended.

If the abdomen is percussed the patient will complain of pain along the edge of the rectus, in the region lying between the incision and Poupart's ligament; but there is no marked tenderness elsewhere, although the patient shrinks from the palpation. The distension so far is a soft one, and the abdomen is everywhere compressible.

Borborygmi tell us that the wind is moving freely about in the intestines, but the bowels evince no desire to act spontaneously, and if an injection be administered it is often retained, or, if passed, it contains no fæces.

After midnight (thirty-six hours) the temperature may fall a degree, but it does not remain stationary for long; while the

pulse, instead of falling, increases, and the respirations are now becoming shallow and rapid (26 to 30).

In the early hours of the morning of the third day the patient may get a little sleep; but when the morning has dawned we see only too plainly that the condition is becoming desperate, for the shadow of death seems cast over her countenance.

As we enter the room the condition of the patient is reflected in the nurse's face, and when we turn to the patient we see in a glance the change that the last twelve hours have wrought. Her face—now grown a lemon colour—shows that she is in pain; it has no flush, it is pale and pinched; her forehead is somewhat wrinkled, and her features seem to be drawn up, and there extends from the nose, downwards and outwards, a well-marked naso-labial furrow. Her nostrils dilate with her short, quick, shallow respirations, which show that her breathing is now thoracic, the abdominal walls being kept quite rigid.

Her tongue is parched, and while it may be 'shrivelled, brown, rough, and dry like the ball of a dog's foot' (C. Martin), it is generally devoid of coat and fur, being quite clean, faintly red, with the fungiform papillæ prominent at the tip, and some cracks here and there—which mark it out, at times, like crocodile hide—but, above all, it is dry and glazed, as though we could almost imagine that it had had the thinnest coat of enamel run over it; it is so dry that we always compare it to the tongue of a parrot. If you ask the patient to spit out, she may make the effort, but all that she can do is to collect a very small quantity of milky, viscid fluid, for the saliva appears to have ceased to flow.

Her attitude in bed is characteristic: she lies with her legs drawn up so that she may release her belly muscles, and keep the bedclothes from pressing on her tender, swollen belly.

From time to time she hiccoughs—or vomits a bile-stained fluid, mixed with whatever she has taken to relieve her unsatiated thirst; but every time she vomits she writhes with pain, as she grasps suddenly at her abdominal walls to endeavour to steady their forced contractions, and when she ceases she lays back, her pulse-rate increased 10 beats and quite exhausted with her efforts, her brow clammy and her face more ashen and her pupils dilated.

Her hands are cold and damp, and they wander restlessly over the bedclothes; she cannot bear the nurse to place them under cover, and she seems to get relief by placing them up over her head.

If now we examine her pulse we shall find it quick, but still hard and long—an angry pulse, whose fluid taps impatiently against contracted walls some 130 times a minute. The temperature, too, is high (102° F.), but it varies remarkably, and, as if seized by some whim, may make a sudden dive downwards towards normal, only to return and rise higher and higher as the end approaches.

If now the abdomen is examined, it will immediately be seen, even before the binder is removed, that there is much distension. The parts about the wound look dry, red, swollen, and strained. The distension is no longer confined to the umbilical and hypogastric regions; on the contrary, the dip that could be noticed between the sternum and the umbilicus no longer exists; from sternum to pubes, from iliac crest to iliac crest the contour is convex, for the colon everywhere has become distended, and causes the lateral regions of the abdomen to bulge out. A hand placed on the abdomen causes the patient to shrink and complain, but it requires little pressure to show us that the whole is like a drum; it is rigid, the tension is increased, and it can no longer be compressed. It is a hard distension, but the patient still feels acutely, and bitterly complains if the fingers are pressed in with any force.

As the third day draws to a close, the patient, unable to rest for a moment, rapidly sinks. The pulse is now 150, small and compressible; the respirations are shallow and rapid (36 to 40), the alæ nasi dilating with every breath; the face is more ashen, clay-like, and pinched (the facies hippocratica); she craves for a drink, for her thirst is insatiable, and though she tries she cannot get a drop of saliva to moisten her lips; the flatus is gulped, hiccoughed, or vomited, with bile-stained and coffee-coloured dark fluid, with fine black particles for a sediment; the borborygmi can no longer be heard; the bowels refuse to act; the urine has ceased to flow into the bladder; the patient no longer shrinks from the hand laid on the tense abdomen, for all sensation has fled; and wearied out, even longing for death, she expires.

Fulminating Peritonitis.—This form of peritonitis is now rare, but it is occasionally seen after sections. It runs a rapid course, and death supervenes during the first twenty-four or thirty hours after the operation, the end being due to the profound nerve irritation, producing shock, caused by the presence of

micro-organisms spreading over the serous surface and poisoning the patient by their virulent products. In these cases the local reaction is slight, and we look in vain for well-marked signs of inflammation of the peritoneum at the autopsy; the peritoneum is found covered by a slimy exudate of fibrin, and the microscope shows that there are myriads of micrococci.

We have, fortunately, had no experience of this variety of peritonitis after sections.

The following case recorded by Howard Kelly shows well the features of this hopeless and fatal complication.

The patient was operated on for multiple myomata of the uterus, the operation taking fifty-five minutes.

She was returned to the ward at 10 a.m., and by six o'clock the same day her temperature had reached 101° F., and her pulse, which had ranged from 80 to 90, suddenly ran up to 120 and 130, and became irregular. Her appearance was bad; the face was covered with cold perspiration, and the expression was drawn. Under strong stimulants the patient improved, but by the next morning the pulse had almost disappeared. The abdomen was tympanitic and tender to pressure.

The symptoms were so rapid in the onset that the possibility of a secondary hæmorrhage was seriously discussed.

The abdomen was reopened, and a few drops of thin, yellowish pus exuded, and the intestines and parietal peritoneum were found covered with a very thin, viscid layer of fibrin.

The abdomen was irrigated throughout and a gauze drain inserted, and salt solution was infused into the radial artery.

Patient regained consciousness, but died within an hour. Her temperature in the early morning hours reached 104·5° F.

Bacteriological examination showed myriads of colonies of streptococci.

Signs and Symptoms.

In referring to the signs and symptoms which have been given in the three varieties of peritonitis, it is apparent that there are certain symptoms common to all three.

Pain and Tenderness.—The pain and tenderness in these cases are due to the distension of the bowel and to the colicky pains from the increased peristaltic movements of the bowels, while the deep-seated pains are caused by the inflamed condition of the serous membrane. Lastly, the skin of the abdomen is always hyperæsthetic in this complication.

At first the pain is referred to the region of the pedicle where the ligatures are placed, and after this the pain and hyperæsthesia spread to the umbilical region, and then over the whole of the abdomen when it is distended. In the last stages of the malady, however, pain is usually absent, and when this stage is reached the case is hopeless, for the bowels are paralyzed and the patient is poisoned.

Gee says that the patient expresses that she is suffering from pain by the wrinkled condition of her face and the drawn-up expression of her features, together with the marked naso-labial fold. The raising of the legs in bed is always an expression of tenderness in the abdomen, and by adopting this position the tension of the abdominal muscles is reduced, and the knees serve to keep the bedclothes from pressing on her; and, further, the patient lies still, for she soon learns that any movement causes her pain, and for this reason her breathing becomes thoracic.

Pulse.—The pulse in peritonitis is almost invariably increased in rate. Its character is altered. The radial vessel is contracted; it is small and hard, but as it has a full stream of blood the arterial pressure is manifested by fulness of the artery between the beats, and it can be rolled by the fingers, not only during, but between the beats, and consequently it is not easily compressible. If, however, the case is complicated with marked shock or hæmorrhage, the radial pulse is not full; it is soft, small, and compressible, for the vessel is not filled.

As the end approaches, the pulse increases in rate until only very small, sharp, short impulses are felt by the finger, and we get the impression that a sphygmographic tracing would resemble in outline the teeth of a small saw.

The pulse is an almost certain guide to the condition of the patient, and if the rate is 140 and it shows no signs of falling in the early hours of the morning, then the patient's condition is more than serious.

Numerous instances have been recorded where the patient had a normal pulse, and yet the abdomen was filled with pus; but these examples of peritonitis are exceedingly rare after sections for diseases of the pelvic organs.

Temperature.—It should be regarded, as a rule, that the temperature rises in cases of peritonitis after operation on the uterus or ovaries, though shock may cause it to fall for a time. The young surgeon is often dismayed to see it stated in text-

books that no reliance can be placed on the temperature chart in peritonitis. We admit we have seen cases of death from peritonitis where the temperature was normal,* but these cases are exceptional; consequently, the gynæcologist may expect that in post-operative peritonitis he will encounter temperatures ranging from 101° to 104° F. in the majority of cases.

Usually the temperature begins to rise after the first twenty-four hours, and while there may be some remissions in the early morning, there is a strong tendency to evening exacerbations; the rise beginning after noon and continuing until midnight; any fall that occurs taking place between 12 and 10 a.m.

But though the temperature may be considerable the patient does not look flushed, except during the first thirty hours; and as the peritonitis advances the patient's face becomes pale, ashen —a lemon colour—but not flushed as in fever, and the brow remains clammy.

If the temperature in peritonitis, after being very high, suddenly falls to normal, or lower, then we may expect collapse, rupture of the bowel, or internal hæmorrhage.

As a contrast to such temperatures we have those in which the temperature runs to 100° or 101° F. soon after the operation, and then shoots up to 105° or 106° F. during the next twenty-four hours. These cases generally end in death. In the one case we must suppose that the febrile reaction has been due to the absorption of substances which depend for their existence on bacteria, while in the other case we must suppose that some product has been elaborated which has acted as an antipyretic. Certain it is that the temperature in some cases is not due to inflammation in the peritoneal cavity, for we may have a very high temperature in peritonitis and almost a total absence of any inflammatory signs. The temperature in peritonitis is therefore to be regarded as an index denoting the degree in which the products elaborated by the different micro-organisms are capable of causing paresis of the heat-regulating centres; and as peritonitis may be due to various species of organisms whose products vary in their power of affecting the heat centres, we can thus explain the fact noted by all observers, that temperature charts show in different cases of peritonitis so much variation that probably there is no affec-

* The cases that linger on until the second week and then die from the eighth to the twelfth day not infrequently die with a normal or a subnormal temperature.

tion, attended with fever, in which the temperature charts of a large series of cases exhibit fewer data for the establishment of a common standard of fever' (Treves), and 'there is no course of the temperature in those affections—*i.e.*, inflammation of the serous membrane—which can be regarded as denoting safety: whatever the course of the temperature, a fatal termination may ensue. No behaviour of the temperature guarantees that the disease shall end in perfect recovery' (Wunderlich).

Tympanites.—Distension of the bowels with gas is one of the first signs that attracts attention. It begins sooner in those cases where opium has been given. The small intestine becomes distended first so that the abdomen swells in the region of the umbilicus. As the distension increases the stomach becomes filled out and forms a convexity in the epigastric region. After this the colon swells and the flanks bulge out, so that when we view the abdomen in advanced peritonitis we find it distended everywhere; the curves in the median line start abruptly from the lower end of the sternum and end at the pubes. During the first stages of the distension we can compress the abdomen without giving the patient great pain, but as the tension is increased and the whole becomes drum-like, it is impossible, without force, to depress the abdominal walls, and any efforts to do so causes the patient great agony.

At first the wind rolls and moves about, causing pain, for the intestinal walls are inflamed, and it is not until their muscular tissue is paralyzed that the wind ceases to roll and pain is abolished.

Some wind may be got rid of if a rectal tube is passed, but the patient is quite unable to expel any by the efforts that she may make, probably because she cannot, or will not, use her abdominal muscles.

In some rare cases there may be no tympanites. This happens when death takes place during the first twenty-four hours, either because the infection is so virulent that the end comes before any considerable quantity of gas has time to accumulate.

Treves says that meteorism may be absent throughout the whole progress of the case, and examples of this are not uncommon in instances of septic intoxication attended with symptoms of a low type; and Kelly remarks that 'the cases in which the abdomen remains flat throughout the course of the disease are the worst forms of peritonitis, in which there

is no attempt at a local reaction, and the patients quickly succumb.'

Tait used to say that he never saw fatal peritonitis in which distension was not a prominent feature, and most surgeons will grant that distension is one of the most reliable signs in diagnosing this affection.

In all cases in which peritonitis is suspected, the binder and dressing should be removed, and the abdomen should be watched attentively. There is a general rigidity about the abdominal walls. The walls do not move with respiration; they are held in a spasm. If we ask the patient to expire by contracting the abdominal walls, she is quite unwilling, and often unable, to do so, and the rigidity is made more apparent when the surgeon endeavours to depress the walls with his hand. The patient cannot be considered in a serious condition so long as we can depress the walls with ease—in fact, so long as we are dealing with a soft distension.

Thirst.—In every section case we have some degree of thirst, but when the patient has developed peritonitis the thirst is generally much increased, and, as Treves remarks, 'the patient is ready to give her life for a drop of cold water.' If this thirst abates about the third day it must be looked upon as a favourable sign.

Tongue.—The patient's tongue is either clean or furred. If the patient has a clean tongue at the outset it will not become furred; if, however, it has a fur at the time of the operation, then we may see the shrivelled, brown, rough and dry tongue, like the ball of a dog's foot, that Christopher Martin describes. Almost invariably the tongue in peritonitis becomes clean, smooth, dry, and glazed—the tongue which we are accustomed to allude to as the 'parrot tongue.' If the tongue remains dry and glazed the outlook is serious; if, however, we find the tongue becoming moist we know that the case is taking a favourable turn.

The patient can hardly be in a serious condition if the tongue remains moist and coated.

Vomiting and Hiccough.—Vomiting is certainly one of the most characteristic features of a case attacked with peritonitis. After the vomiting, due to the anæsthetic, has ceased, the patient may not exhibit any tendency to vomit until the third day; usually, however, we have no break, and instead of vomiting

ceasing at the end of twenty-four hours it rather increases. It may not be violent, and but little may be expelled, but the alarming feature is the persistency with which it continues.

If we endeavour to feed the patient the food is soon expelled; if we give only sips of fluids this is gulped up; if we give nothing by the mouth, we find that the patient after two or three efforts brings up some mucus mixed with green or yellow bile-stained fluid, and at the same time expels some flatus by the mouth. As the vomiting continues it gives our patient no rest, and the vomited matter becomes darker and darker, until it becomes black like coffee-grounds; and if the case survives any length of time the vomited fluid may become stercoraceous, but not fæculent. As the vomiting exhausts the patient we find that she breaks out into a perspiration, and after each attack her pulse is quickened, and at times becomes intermittent.

In some cases the patient does not vomit, but only hiccoughs; while in other cases she gulps up a little discoloured fluid very persistently.

Tait used to lay stress on the bilious vomiting, and he was accustomed to say that if the peritonitis began to abate, one of the first signs indicating the favourable termination was a diminution in the quantity of bile in the vomit; but if, on the other hand, the peritonitis was gaining ground, then the bile-stained fluid rapidly gave place to the coffee-ground matter.

Some observers say that if the case is treated from the outset with opium, the green vomit is conspicuous by its absence.

We regard this black colour of the vomit as an indication of the presence of blood, the corpuscles having found their way through the capillaries and become broken up so that the hæmoglobin then becomes converted into hæmatin. The reason for this escape is the septic condition of the patient, combined with the engorged condition of the hepatic and portal vessels.

Constipation. — The bowels do not attempt to act unless stimulated by strong purgatives or by rectal injections, and as the inflammation increases, and the paralysis becomes more marked, distension increases, and constipation becomes absolute, especially if morphia has been administered to relieve pain.

Though we may often get diarrhœa in cases suffering from puerperal septicæmia with peritonitis, it is seldom that we encounter it in the class of cases that we are dealing with at present; we have, however, seen an instance of intense diarrhœa

which occurred in a case where peritonitis set in after vaginal hysterectomy.

Urine.—The urine is usually scanty and high-coloured, and occasionally may contain albumin. It is voided with difficulty; a good increase in the quantity of urine secreted is a favourable sign.*

Blood.—An examination of the blood shows a large increase in the number of leucocytes in all cases, except when the organism is overwhelmed, and offers no resistance.

Thoracic Breathing.—This is always a marked clinical feature of these cases when the inflammation is advancing in severity. The belly walls become rigid, and the diaphragm's upward and downward movements become very limited, probably because it becomes paralyzed to some degree, and also because its movements increase the abdominal pain. The patient finds that thoracic breathing gives her most ease, and so she adopts a form of breathing more easy for women than for men to practise. But being unable to get sufficient air for her needs, her respiratory movements are increased in rapidity, and with each inspiration the alæ nasi dilate.

Facial Expression.—Tait says 'the alteration of the face I most fear is not one of pain, but of anxiety, accompanied by a tendency to chatter and ask questions. If a patient will be quiet and not talk she is pretty sure to recover; if she persistently chatters she is pretty sure to die. On relief of the symptoms, which practically means getting the bowels to act, the face becomes placid, and the patient quiet.'

A patient with peritonitis may be quite still during the first stages, and when the end is approaching she may become restless, because pain has disappeared from her abdomen, and she knows that movements will not cause her the agony they did when she lay with her legs bent, even fearing lest the bedclothes should touch her tender abdomen.

During the first stages of peritonitis the patient's face expresses the pain that she is suffering, and this is indicated by the slight wrinkling of the forehead, and the well marked naso-labial furrows.

* Von Brunn (*Archiv f. Klin. Chir.*, 1901, vol. lxv., No. 1), after examining the kidneys in twenty-one cases after cœliotomy, concludes that necrosis of the epithelium of the kidney almost invariably occurs in connection with peritonitis.

The face may be in the early stages somewhat flushed, but when the peritonitis is well advanced it is pale, pinched, drawn, and it may have a tinge of yellow in it, while the forehead is damp with perspiration, and the eyes sunk back in the sockets—the *facies hippocratica.*

Lipothymia.—This term is used by Gee to express that marked failure of the vital functions—of the circulation, respiration, and body heat—which so often occurs towards the close of a fatal peritonitis. The small, weak, irregular pulse, the weak heart-sounds, the shallow breathing, the lividity and pallor, and the failure of the body heat—as far as the surface is concerned—mark the approach of death, for they are the visible signs of failure of the vital functions.

Diagnosis and Differential Diagnosis.

The diagnosis of mild cases of peritonitis is attended with difficulties, because the symptoms presented are not sufficiently pronounced or differentiated from other complications. Thus in cases where traumatic fever follows an operation we may have quite severe vomiting and distension; but time clears up our doubts, and while the symptoms of traumatic fever disappear on the third day, those of peritonitis increase, and the patient has reached her crisis on the third or fourth day, if, indeed, she has survived so long.

The chief points to be considered are:—pain, pulse, distension, temperature, vomiting, respiration, and facial expression.

Many of these severe cases of peritonitis leave us in no doubt, but we may at times have to differentiate between peritonitis and shock, secondary hæmorrhage, excessive tympanites, pseudo-ileus, intestinal obstruction, stitch abscess, wound infection, septicæmia, pneumonia, and abdominal influenza.

Prognosis.

If the peritonitis is localized it does not threaten the patient's life, but it may by causing adhesions tend to intestinal obstruction or pseudo-ileus.

When the peritonitis is not localized, but is general, it will always cause us anxiety, for while one patient may be able to withstand quite a severe attack of peritonitis, another patient succumbs to what is apparently quite a mild attack. And in

this connection it is well in considering the prognosis in cases of peritoneal infection to bear in mind the views put forth by Fritch of Bonn.

He says, in speaking of the causes of death after laparotomy, 'that the most important organ was the peritoneum. In the peritoneum the physiological and pathological changes were very rapid. The time required for adhesion to take place was rather minutes than hours. Cocci were rapidly swept from the peritoneum into the blood and destroyed. But for cocci to become harmless three things were necessary: First, they must not be in too great a quantity. Secondly, an undisturbed circulation and a healthy heart were necessary; a lengthened operation, chloroform narcosis, loss of blood and cooling injured the circulation. Possibly also the hæmoglobin and the chemical quality of the blood had to be taken into account. Thirdly, the functions of the tissues—here the peritoneum—must be normal. The cooling was of less moment than the contact with the air and the altered pressure after opening the abdomen. The injury thus caused was often visible to the eye. The injury to the peritoneum was the greater the more roughly and improperly it was treated. Even without direct infection the operation might be dangerous. It must not be forgotten also that cocci accidentally introduced, or coming from the intestines, might, under these circumstances, find conditions suitable for their growth. Generally the weakened intestines recovered their tone in a few hours. If, therefore, after twenty-four or more hours the heart was strong and the pulse good, there was no danger. But with a weak heart and a quick pulse the normal function of the bowel was not restored. He had shown, then, that independent of infection there were two conditions closely connected with each other that were dangerous—viz., weakness of the heart, and injury to the peritoneal and intestinal functions. Avoidance of infection was not the only important thing, as had hitherto been represented, but the maintenance of the general and local power of resistance.'*

Where the infection has been by virulent matter, the prognosis will chiefly depend on whether the resulting peritonitis is localized or diffused; the pyogenic properties, the number of organisms present, and the susceptibility of the subject, are the factors that

* German Gynæcological Society, 1896, quoted by Macnaughton-Jones.

come into the reckoning in estimating the patient's chance of recovery. There are times when the very smallest amount of virulent infectious material appears to be quite sufficient to overwhelm the subject, whether the patient be in a favourable or an unfavourable condition for resisting. This fulminating species of peritonitis is always a hopeless condition.

Again, we must remember that while the trouble remains localized we may reasonably hope to attack it with success by an operation, whereas a non-purulent diffuse peritonitis is infinitely less amenable to operative treatment.

Tait was wont to consider that time was the most important element in a case of peritonitis. 'If the grave symptoms are all matured on the fourth day after an operation, a fatal issue is pretty certain. If they hang over till the sixth, or later, the chances of the patient's recovery increases in a geometrical ratio, always excepting cases of hysterectomy. . . . My opinion is that the outcome of a case of peritonitis depends far less on the severity of the symptoms than on the time over which they run. These symptoms may be quite parallel in two cases, and yet one will die on the fifth day, and another will go on to the twelfth and get well, the symptoms lasting all the time with almost initial severity.'

It appears to us that the time that elapses between the infection of the peritoneum and the death of the patient is in direct proportion to the rapidity of the absorption. Consequently, a fulminating peritonitis is one in which the absorption is so rapid that death takes place before the peritoneum has had time to develop those barriers which macroscopically are the signs of peritonitis, and which are the efforts which the peritoneum makes against absorption along its lymph channels. Consequently, the longer the patient lives, the better chance has the peritoneum to check the absorption of the products of the infecting micro-organisms.

Treatment—Prophylaxis.

Tait has said: 'It is no use talking about treating peritonitis; you have not a chance as a rule; you must prevent it.'

The directions which we have given in the first part of this work with regard to the operating-room, and the preparation of the instruments, and dressings, and the surgeon's hands, are practically the outcome of the modern fight against peritoneal

infection. We may go so far as to say that the peritoneal cavity has been the battlefield and the testing-ground for all the innovations made both under the antiseptic and aseptic régime. In the past the peritoneum has always been regarded as a membrane peculiarly susceptible to infection; this is no doubt quite true, as at the same time is the opposite statement, that the peritoneum is a membrane that has an extraordinary power of withstanding and overcoming the attacks of infectious micro-organisms. In fact, the peritoneum may be contaminated, and the patient may suffer little inconvenience, whereas if the same micro-organisms were introduced into a clean-cut wound—as, for instance, while performing the radical cure for an inguinal hernia —suppuration and all its attendant ills would supervene. On the other hand, while the peritoneum can withstand some kinds of infection well, it appears to have at times no power whatever to combat the onslaught of even minute quantities of some micro-organisms — such, for instance, as the *Streptococcus pyogenes*. Inasmuch as germ infection is the cause of most, if not all, of the cases of peritonitis that we are now considering, our chief prophylactic measures are directed against the introduction, or the liberation, of the *Streptococcus pyogenes*, the *Staphylococcus aureus*, the *Bacillus coli communis*, and the *gonococcus*.

In the past, the hands, instruments, and ligatures, introduced the germs; but the exquisite care that is now lavished on all these conveyers of infection has made infection from without quite a rare event: consequently, our chief difficulty in performing a section is to prevent contamination of the peritoneum by that which is already contained within the abdominal cavity.

With regard to infection introduced from without, there can be little doubt that the surgeon's hands are more often at fault than his ligatures, sponges, and instruments, and consequently the introduction of rubber gloves is one of the greatest advances that has been made in recent years towards minimizing this trouble.

An occasional accidental contamination may occur, as, for instance, the one related by Kelly. This surgeon operated on a woman with eczema of the abdominal walls, and she died of a virulent peritonitis, the germs being conveyed from the eczematous patches during the course of the operation.

Contamination of the peritoneum is produced in those cases where the operation is commenced by the vaginal route—as in

cases of cancer of the cervix—and finished by the abdominal route. Here the operator's hands become infected, and it is impossible to sufficiently sterilize them. This means of infection, however, is rapidly disappearing since surgeons have adopted rubber gloves during the abdominal and vaginal portion of the operation.

With regard to infection from within, this may come from germs contained in pelvic abscesses, whether situated in the Fallopian tubes, ovaries, broad ligaments, or the pouch of Douglas. But even when pus is not present we may have a peritonitis set up some days after an operation, through the germs finding their way through the damaged walls of the intestines, or through the incision made in the uterus after removing a growth or a fœtus; or we may get the infection from the abdominal wound.

With regard to collections of pus, much can be done to prevent infection during the course of the operation, and undoubtedly the more experienced the operator, the fewer deaths does he have when dealing with such cases, because his perfected technique enables him to guard against the spreading of the infectious matter in the peritoneal cavity. He is able to remove tubes swollen up with pus without rupturing them, or his ready touch tells him when he should not attempt to remove them, but should be content to tap them and drain them by the vagina—a procedure that has largely reduced the death-rate of cases affected with pyosalpinx.

On the other hand, if he determines to aspirate the abscess, and then to enucleate the sac, his careful arrangement of sponge and sponge-cloths enables him to perform these steps without allowing any of the purulent contents to escape; and he is still further aided by using a small bag to envelop the pus sac in, so that his fingers likewise escape infection. Then at the conclusion of such an operation an experienced operator sees readily whether his hæmostasis is effective; he knows only too well that an oozing surface will supply in a short time sufficient blood and serum to form a ready culture medium for germs, which either escape from within during the course of the operation, or are introduced from without through a drainage-tube, which is employed because the hæmostasis has been imperfect.

When such a surgeon fails, his failure is often due to the fact that though the operator and his assistant may not allow much

pus to escape while removing the pus sac, yet the quantity that does come in contact with his fingers, or his sponge, or the peritoneum is quite sufficient to prevent him effectually disinfecting the part contaminated.

Thus, while he may remove his soiled sponges and wash his hands, this is insufficient to insure disinfection, and each step that follows is a further contamination over a wide field by means of the hands and instruments; for the fact becomes plain to us that there is pus so virulent that the quantity necessary to cause infection is infinitesimal, and the escape of the most minute quantity means a virulent infection. Such pus is usually pregnant with *Streptococcus pyogenes.*

Another subject intimately connected with prophylaxis is whether after contamination we should irrigate the area, or be content with sponging.

It is useless to even attempt to say which plan will give the better results in a series of cases. There are surgeons who argue that to irrigate is to spread the infection from a small focus over a wide area, such an argument being immediately answered by the retort, that in spreading the infection over a wider area we are at the same time attenuating it, bringing it into contact with healthy peritoneum, which is better able to deal with it than the damaged tissues of the pelvis.

Other surgeons make it a rule to sponge, and content themselves with getting rid of any pus or cyst contacts that are visible to the eye, maintaining that as disinfection of a contaminated surface is impossible, the ultimate result will depend on the nature of the micro-organisms. Should the germ be virulent, neither irrigation nor sponging will be of any avail, whereas if the germs are not virulent, then the peritoneum may be relied upon to deal successfully with them.

There is no unanimity; either or both views prove successful, and, like so many other points in connection with infection, a successful end may be obtained by absolutely different technique. Even if both views are correct, there is this to be said in favour of irrigation, that it serves to arrange the intestines in a more normal disposition, and so prevents kinking.

We ourselves have great faith in irrigation, and this was one of the points that Tait laid much stress on. He repeatedly remarked that he saved cases by irrigation when others would have lost them if they had not adopted this procedure.

If the sponge be adopted we must bear one point in mind: it must be used with a gentle hand, so that the epithelial lining may not be damaged, or the germs be actually rubbed into it. We should remember that it has been conclusively shown by Grawitz, Wegner, Fraenkel, and others that while the staphylococcus and other bacteria may be introduced without ill results into the peritoneal cavity, 'suppurative peritonitis follows if the serous membrane be previously damaged' (Lockwood); therefore, do not with a sponge caught in the jaws of a pair of forceps rub here, there, and everywhere in the peritoneal cavity, as though you were cleaning the inside of a dirty bottle.

When for any reason we adopt the sponge instead of irrigation, we think that, after cleaning the surface with saline solution, sponging it with pure peroxide of hydrogen is an extremely valuable procedure. We are quite aware that by doing so we are actually opening up channels for absorption, but we do not regard this as a sufficient reason against a procedure that we have practised with success for several years.

Lastly, whilst the writings of Olshausen, Zweifel, and Howard Kelly have caused us to abandon the drainage-tube, we still think that this abolition of drainage, while it may have had no effect in determining the results of operations performed in rigidly conducted aseptic clinics, has deprived the unskilful of prophylactic measures against peritonitis which they cannot afford to dispense with at present.

Therapeutic Treatment of Peritonitis.

In the 'fulminating' cases nothing can be done for the patient beyond the routine treatment for shock; the disease runs a rapid course, and death soon cuts short the patient's suffering.

The cases for which something can be done are those that are often regarded as instances of **traumatic peritonitis**, but which we have alluded to as instances of mild septic peritonitis.

Grave forms of septic peritonitis may get well with or without operative treatment, but medicinal treatment in these cases is of little avail once the disease is well established.

At the end of forty-eight hours we can usually tell if the patient has developed peritonitis, and if this be so we should pay attention to the following points:

We should secure the patient's comfort by raising the bedclothes off the tender abdomen by means of a cradle. We should

then place at a short distance from the foot of the bed a padded block of wood shaped like a prism, which may be secured to either side of the bed-frame. The patient rests her feet against this as she lies on her back with her legs drawn up. The same end may be imperfectly achieved by placing a large firm pillow under the flexed knee of either leg. Unless one of these plans is adopted, the patient will grow weary endeavouring to support the bedclothes while her feet are continually slipping from her.

With regard to warmth, we may have hot-water bottles in the bed; but if the patient complains of heat, on no account distress her by persistently placing hot-water bags around her. If she will persist in having her hands and arms above the bedclothes or over her head, then a flannel bed-jacket should be slipped on, else the arms and hands will grow cold and lifeless.

With regard to food, we must keep up the patient's strength by the administration of liquid food. If the patient is not vomiting we may give a little by the mouth, but we must not fall into the error that because the patient is not vomiting the stomach is absorbing the nourishment administered.

If it is a case of severe peritonitis, vomiting is sure to be a marked feature, and feeding the patient by the mouth in such cases is mere waste of time, for the food is again and again vomited back mixed with bile. In fact, so long as the bile is poured into the stomach, as Tait used to say, there will be no hope of any absorption from the stomach. Consequently, we must rely on nutrient enemata. These will consist of peptonized milk with eggs, and Carnrick's peptonoids. These enemata should not be administered more often than every four hours, great care being taken that the injected fluid is not concentrated or irritating, the latter evil being avoided by not administering large quantities of spirits in the enemata.

If the enemata are not retained, and the patient is vomiting, it will be wise to stop all food by the mouth and bowel for four hours or more, administering in the meantime an enema of starch with 15 drops of laudanum, so as to lessen the irritability of the mucous membrane; or we may insert a suppository of morphine ($\frac{1}{8}$ grain) or of cocaine ($\frac{1}{2}$ grain) combined with oxide of zinc (4 grains).

As regards vomiting, it is useless to treat this by drugs, and it is probable that the actual vomiting is serving a good purpose by

ridding the stomach of the bilious fluid poured into it. If, however, the patient is strong and can stand it, the stomach may be washed out with the stomach-tube. This at times gives hours of rest to the weary patient. In some cases we have given a cup of hot milk, which the patient has almost immediately vomited, and by this means obtained relief.

With regard to stimulants, we may give brandy, whisky, and champagne, either by mouth or along with enemata; and if we have occasion to give a submammary saline injection, a few ounces of brandy and a drachm of digitalis may be added to it with benefit. Strychnine may be given freely.

Should the patient's temperature be persistently high, we may resort to cold sponging and packs. Some surgeons apply Leiter's coil, others place ice-bags on either side of the neck, while there are some who prefer to administer antipyrine. All of these plans are effectual in reducing pyrexia; the point to be considered is whether we are not doing more harm than good. Continued hyperpyrexia should certainly be treated.

Thirst is, of course, one of the tortures that the patient has to put up with, and this is best relieved by submammary injections twice a day, while if the bowel is not irritable we may use it as a channel for introducing saline fluid with the same object. A little ice cream gives the patient great relief, and often causes a lull in the vomiting.

The tongue is dry and glazed, but may become coloured with the bilious vomiting, and the patient will complain of the sour taste in her mouth; sips of Vichy water relieve this. The mouth should not be allowed to become foul; the patient is directed to rinse it out with some warm boracic acid, or with some bicarbonate of soda solution, or a little weak Condy's fluid.

If the mouth becomes very offensive, the nurse should wrap a little strip of gauze round a wooden skewer and clean the mouth with a weak solution of peroxide of hydrogen. Then we may smear on the tongue a little glycerine with a few drops of fresh lemon-juice squeezed into it. Sanitas and soloids* of boracic acid, scented with otto of roses, make a most agreeable mouth-wash for these cases.

As the peritonitis increases the patient will suffer considerable pain in the abdomen from the inflammation and from the

* Burroughs, Wellcome and Co.

tympanites. As we cannot give her opium we must endeavour to relieve her distress with hot packs or ice-bags.

We prefer boracic acid fomentations. A large piece of lint, large enough to cover the anterior part of the abdomen, is placed in a hot boracic solution. In another basin is placed a large sheet of spongiopiline. The lint is wrung out and placed on the abdomen, while the spongiopiline is placed on the lint, and the whole is fixed in position by a Turkey towel, which acts as a very effectual and comfortable binder. Some prefer to employ turpentine stupes, as the counter-irritation is greater. We have frequently, in treating cases of peritonitis both before and after operations, first applied hot fomentations until the skin was very hyperæmic, and then applied a thick plaster made by spreading soft soap* on the lint. It is surprising how rapidly and effectually this relieves abdominal pain. Besides relieving pain, these hot fomentations serve a good purpose in keeping up the action of the skin, for as the disease advances the quantity of urine excreted becomes greatly diminished, and if the patient has been suffering from some chronic kidney affection her chance of recovery is now greatly diminished.

If we pause now to consider the means we have employed in treating peritonitis, we must at once admit that the treatment might equally as well have been used for treating a case of typhoid or pneumonia; we have, in fact, done nothing that will strike at the root of the trouble. We must, therefore, turn to consider what is held to be one of the sheet-anchors in the treatment of peritonitis—*i.e.*, purgation.

Tait† in 1886 wrote thus: 'On the slightest indication of peritonitis after an ovariotomy we give a rapidly acting purgative, it matters not what; the patient's bowels are moved, and the peritonitis disappears. This practice I introduced in 1875.' Up to the time that Tait introduced the purgative treatment opium had been the universal remedy for peritonitis, although it may be noted that purgatives had been extensively employed at the beginning of the nineteenth century.

At present surgeons are by no means unanimous in their opinion as to the efficacy of purgation in cases of peritonitis.

* Professor Fehling, of Basle, first drew our attention to the use of soft-soap in abdominal cases.

† Lawson Tait. One hundred and thirty-nine consecutive ovariotomies without a death (*British Medical Journal*, May, 1886).

The majority of surgeons who have extensive practice in abdominal surgery hold that while they are quite unable to explain how purgation does benefit the patient, nevertheless, experience teaches that if during the second twenty-four hours after an operation the patient's abdomen begins to get distended, and this is accompanied by vomiting and a rise of temperature and pulse-rate, the administration of a purgative, followed in a few hours by an enema, causes an evacuation of the bowels and the passage of large quantities of flatus, after which the pulse-rate is lessened, the temperature falls, the abdomen becomes flat, and vomiting ceases. The advocates for purgation maintain that the symptoms mentioned above indicate commencing peritonitis, and they claim that the administration of a purgative frequently averts this peritonitis; and, further, that purgation, by depleting the portal system, causes absorption of fluids from the peritoneal cavity, and by so doing leaves no ready medium for micro-organisms to multiply in.

Malcolm* and others maintain that when these unfavourable symptoms are removed by a saline purge, the case is one of obstruction or paretic ileus. He says that, however brought about, it frequently happens, when the constipation, distension, and vomiting are relieved, that the temperature rises, and sometimes rises rapidly. Such a rise of temperature after an operation is one of the surest signs of an increase of inflammation. Hence, if the unfavourable symptoms removed by the action of purgatives be attributed to peritonitis, we arrive at the contradictory conclusion that, in many cases, as the symptoms of peritonitis get better the inflammation itself increases.

Greig Smith makes the following remarks on such arguments: 'We seek to distinguish between true peritonitis and simple paretic ileus; purgation is said to be useful for the one, and not for the other. It is difficult to see how this can be proved. All are agreed that the early stages of peritonitis are clinically indistinguishable from pseudo-ileus. If a purge is given, and the symptoms disappear, who shall say which it was?'

Whatever theoretical arguments may be urged against the administration of purgatives, the whole world now agrees that the moment the abdomen begins to become distended after a section, we should employ purgatives or enemata.

But many now go further than this. They, as a routine

* *Lancet*, July, 1891.

treatment, anticipate the onset of the unfavourable symptoms by administering purgatives before the operation and as soon as the patient is placed in bed after the operation, and this practice has been attended with very excellent results.

In choosing the purgative that we shall administer when distension is present, we must be guided by the condition of the patient. If the patient is vomiting continually, we may try small doses (a drachm) of sulphate of magnesia every hour; but if this is repeatedly rejected it will be better to resort to calomel, or to the compound elaterium powder. If the patient rejects all of these drugs, we must resort to croton oil, two drops on sugar or placed in a capsule. We must bear in mind that the object we have in view is to get flatus to pass continually, while the bowels are to act occasionally. We may, therefore, constantly use the rectal tube to help the passage of the flatus, and we should from time to time give a turpentine and alum or a quinine enema.

'If distension increases, we must never rest till we have had the bowels moved' (Tait).

Time is of great importance, for if we once let the peritonitis get well advanced, purgation will probably be useless. Tait himself recognised this fact, for he said: 'I have never said that the purgative treatment will cure peritonitis, for peritonitis, once it is completely established, is a practically incurable disease, and almost uniformly fatal. But when it is completely established I do not know. Of this I am certain, granting a large number of cases going on to peritonitis after operation, or from any other cause, if you subject the patients (not the peritonitis) to the purgative treatment, the number who will go on to incurable peritonitis will be absolutely fractional compared to what will be the result if they are left alone or submitted to any other treatment which has come under my notice.'

When called in to a case of well-established peritonitis, I always urge a trial of this treatment, because the stage may not have passed at which it may still be effective, but the chances are that it has.

Greig Smith always tried purgatives in septic peritonitis. He remarks: 'It is said by some that in septic peritonitis purgation is useless. I doubt this. Free purgation depletes vessels, and causes absorption of peritoneal fluids; deprivation of fluids means starvation of germs. Also a non-distended gut and an

uncompressed peritoneum are physiologically active, and they can dispose of noxious matters; purgation provides both conditions. Septic or non-septic, traumatic or paralytic, there is abundance of proof to show that intestinal purgation is the best-known treatment of the distension which supervenes in abdominal operations.'

But though we are only too willing to believe well of purgation, we cannot blind ourselves to the fact that the ultimate fate of a patient who is attacked by peritonitis depends *not* on whether flatus passes or the bowels act or do not act, but on the condition of the patient's organs—kidneys, heart, liver—on the virulence of the infecting germs, on the quantity of the infectious substance, and on the idiosyncrasy of the individual. We have all grown to believe that when the bowels do not act the patient dies largely *because* the bowels do not act. May we not say that when the bowels do not act this is a sign that the patient is so poisoned that the bowels have no power to act, for they are paralyzed by the circulating poison? If the bowels act, then this is a sign that the poison has not got complete mastery of the organism. In those cases where we get profuse diarrhœa with peritonitis, then the poison circulating is probably entirely different to the poison that we are usually called upon to deal with after pelvic sections.

As we have already said, the idiosyncrasy of the patient must be considered. It is necessarily a complex factor, but we can easily believe that in some women there is a 'natural immunity,' which depends on vital reactions that are called forth by the conflict between the toxins and the bacteria with their products, the final outcome being death of the micro-organism and neutralization of the toxins. The destruction of bacterial life is assisted by the innate germicidal and antitoxic powers of the surviving plasma, or lymph, found in many animals, and by the phagocytic properties of the wandering cells (Kanthack).

We can also believe that, if before the operation the patient has been absorbing minute quantities of toxins from the diseased area, these serve to give her a certain amount of resisting power by increasing the reactionary vitality of the tissues.

These remarks lead us, then, to this statement, that the keynote to our future success in treating peritonitis will rest on the employment of antitoxins; for while purgation helps us very greatly, still, 'when once general peritonitis has established

itself, an aperient is without avail' (Treves). The reason is obvious: peritonitis is not a local disease only; it is a general toxæmia, and death is not due to the inflammation of the serous membrane, but to the effect of the poison absorbed. For this reason it is necessary to attack the local condition, so as to stop the manufacture of the toxins, but at the same time we must not neglect to try and counteract the poisons already absorbed.

Up to the present little good has been done in the way of treatment with antitoxins, but of late we have made some advance in the operative treatment of peritonitis, and we shall now proceed to consider this aspect of the after-treatment.

Operative Treatment of Peritonitis.

The operative treatment of peritonitis may be considered under two headings:

1. Operation when the peritonitis is localized.
2. Operation when the peritonitis is diffused.

In the one case we seek to relieve a localized inflammation which may become general; in the other case we try to check the progress of a diffused condition which is causing a general toxæmia.

Treves says that 'the operative treatment of general diffused non-tubercular peritonitis has, so far, no record to boast of, and little progress to chronicle. I am doubtful if a single human life has been saved by surgical interference in a genuine case of peritoneal toxæmia.' This statement does not represent the opinion of a large number of surgeons; on the contrary, there is abundant evidence since this was written in 1894 that operative treatment may at times be brilliantly successful in a general diffuse peritonitis, and Treves in his latest writings takes a more hopeful view of the matter.

The first difficulty that the surgeon encounters is to decide when and in what cases he should operate.

We know that if the case is really one of septic peritonitis every hour we delay is endangering our patient's life, while on the other hand we may be in doubt as to our correct diagnosis, and to make a mistake and put the patient to the pain and shock of a second operation may be quite sufficient to turn the balance against her. Less harm, however, will be done by reopening a patient without peritonitis than by neglecting to reopen one whose abdomen is becoming full of pus, effusion, and germs.

Even such an experienced surgeon as Howard Kelly finds it a difficult matter to decide when to reopen in some of these cases. He says: 'I know of no class of cases in which it is more difficult to decide when to operate and when not to operate, and in spite of a wide experience and a careful study of all the clinical signs in each case, I still occasionally make mistakes, and open the abdomen, to find no peritonitis when it was believed to be present, or, thinking the symptoms will subside, I wait until it is too late and the disease is beyond control. This liability is due to the fact that in its early stage a septic peritonitis may simulate a variety of simple complications, making a differential diagnosis absolutely impossible.

'If any definite rule could be laid down by which we could recognise a septic infection in its incipiency, the rule would be to reopen the abdomen at once and clean out the peritoneum.'

In endeavouring to come to a conclusion as to whether the condition is one of septic peritonitis, we should be largely influenced by what we have learnt from the operation itself. If the part removed contains septic organisms, we shall have less hesitation in operating than if the tumour had been, say, a simple ovarian cyst or a hydrosalpinx. Again, the place where the operation is performed, and the circumstances under which it is performed, are factors of extreme importance in weighing fine points.

The patient's general appearance, her pulse, her temperature, the presence of tympanites, the character of the vomiting, and the vomited matter, must each be gone over so as to enable us to differentiate between septic peritonitis and an intraperitoneal hæmorrhage, a pseudo-ileus, or an intestinal obstruction; and as each of these conditions may call for operative interference, we are comforted by the fact that if our diagnosis should be wrong, then the operation may yet be useful in relieving these conditions, if any of them be present.

The recent advancement made in the study of the blood will no doubt in the future be an aid in helping us to determine when pus is forming.

Having determined to operate, the next points to be decided are **when** it shall be done, and **what** shall be done.

If the case be in a hospital, the patient should be conveyed to the theatre on a trolly; if the case be in a private house, the table should be prepared, and should be moved into the room

when the patient is under the influence of the anæsthetic. We strongly condemn operating when the patient is in bed; the surgeon is hampered, and the operative procedures are probably only carried out in an imperfect manner.

In all cases, when possible, an anæsthetic should be given. Some surgeons advise ether, others chloroform, some cocaine and morphine.

Abbe inclines to ether because it is best for its stimulating effect on the cardiac muscle, already weakened by the action of the absorbed toxins; and he would aid the general anæsthesia, and diminish the amount of ether required, by a preliminary hypodermic injection of morphine.

If, however, the case is in a serious condition, a general anæsthetic might prove fatal; cocaine and morphine are then valuable, but we must be very careful in our use of morphine.

Kelly prefers chloroform because of its speedy action, and he thinks that cardiac failure, in a heart already depressed by septic poison, is more likely to follow the struggling and vomiting attending the administration of ether.

In the cases that we have operated on we have given a preliminary hypodermic injection of morphine ($\frac{1}{8}$ grain), atropine ($\frac{1}{100}$ grain), and strychnine ($\frac{1}{20}$ grain), after which chloroform has been administered; and when the operation commences ether is then given, only sufficient being administered to just keep the patient under.

When on the operation-table some surgeons think that it is very necessary to wash out the patient's stomach if the vomiting has become stercoraceous. Abbe says that this apparently simple procedure obviates in a surprising manner many of the dangers of a general anæsthetic. There will be no infection of the air-passages, with a subsequent septic pneumonia, because the patient does not regurgitate, as she would have done, the foul contents of her stomach and upper bowel; and there is less likelihood, also, of persistent vomiting after the operation, and the patient thus gains a period of relief and quiet. These are excellent arguments.

When the patient is under the influence of the anæsthetic, a vaginal examination should be made to see if there is a localized inflammation or effusion in the pelvis that will explain the patient's serious symptoms, and which can be attacked by a vaginal incision. In a case in which we had removed a large

fibroid, leaving behind the cervix, the removal of the latter a week after the first operation enabled us to drain away a pocket of pus, and the patient's alarming symptoms immediately subsided and she recovered.

Vaginal section has a limited scope, but at times it is a very valuable aid. Vaginal puncture was much resorted to in Spencer Wells's day, when large quantities of septic fluids were wont to collect in Douglas's pouch after a section had been performed. Thus, in one case Wells says: 'She continued doing well till the 22nd (ninth day), when, after a sleepless night from pain and flatulence, she was found in a state resembling typhus fever—dry tongue, dilated pupils, flushed face, and drowsiness.' Wells examined the vagina, and, detecting fluid, he made a puncture and let out 5 ounces of dark, bloody serum. Next day he evacuated 10 ounces of fluid more putrid than that of the day before, and containing pus. The patient recovered.

The opening into Douglas's pouch may be made either with a trocar whose cannula consists of expanding sections, or we may use a long, sharp-pointed pair of scissors. If the fluid that escapes is very offensive, we may insert a double channel catheter and irrigate the abscess cavity, taking care to have the reservoir containing the irritating fluid hung very low, so that the stream of saline fluid will have but little force. In no instance should we attempt to irrigate unless we have a free incision by which the fluid can escape. In the majority of cases the safer plan is to content ourselves with wiping out the abscess cavity, and then packing it with iodoform gauze.

If we do not employ gauze we may use a rubber tube with a transverse bar made to resemble a cross, and this may be allowed to remain in position while the discharge is profuse; or we may fix the tube in by a suture of silk-worm gut. If we employ gauze we may remove it on the second day, and clean the parts with swabs dipped in a very weak solution of peroxide of hydrogen.

If, however, the vaginal examination shows us that the trouble is not localized in the pelvic cavity, then we must proceed to reopen the abdomen.

The patient should be placed on the operation-table surrounded by hot bottles; the Trendelenberg position should not be adopted, and a submammary injection should be given while the operation is proceeding.

Before opening the abdomen we should wash the skin surrounding the wound with an alcoholic solution of iodic-hydrarg., and then with pure peroxide of hydrogen.

At first we need only cut the two lowermost sutures, forcing the sides of the wound apart with retractors. After opening the peritoneum with care, lest the intestines should be adherent to it, we insert a finger and endeavour to ascertain the real condition of affairs.

If we can satisfy ourselves that the trouble is more or less localized, we need only swab the parts out either with saline solutions or with iodic hydrarg. solution (1 in 4,000), and after this we insert either a glass, a rubber, a gauze, or a wick drain.

If, on the other hand, we are not satisfied that the trouble is purely local, we must proceed further. In fact, it may be regarded as a rule that when in doubt we should consider that the trouble is a general rather than a local one; for, not only is it impossible to tell a virulent from a mild peritonitis anatomically, but experience shows us that often those cases which exhibit the most signs of reaction are the most favourable to treat, and that a patient may survive when the peritoneal cavity is literally filled with pus. We must regard the clinical picture of the sepsis quite as much, if not more, than the pathological appearance presented by the peritoneum.

The first step is to remove several of the sutures from the abdominal incision, so as to give ourselves plenty of room to work in. We then proceed in one of the following ways, always bearing in mind that whatever is done must be done *rapidly*, and with the least amount of traumatism, so as to minimize the shock of this second operation on an organism that is already suffering from the traumatism of the previous operation, and whose resisting power is now much reduced by a rapidly advancing toxæmia.

The first step should be to mop up any fluid, and after a careful exploration (taking care not to unnecessarily break down adhesions) we should next proceed either to irrigate the peritoneal cavity, or to remove the intestines from the abdominal cavity—taking care to avoid putting tension on the mesentery—and wrap them in a gauze towel wrung out of hot water, after which we proceed to wash out and cleanse with swabs all parts of the peritoneal cavity, including the cavity of the lesser omentum. Then the smaller intestine may be wiped with sponges, so as to thoroughly

cleanse it, a stream of hot saline (105° to 110° F.) being directed over it during the whole process, so that the serous surface will not only be cleansed, but at the same time it will not dry.

It is obvious that if the patient is very weak this evisceration will produce so much shock that the patient may become collapsed and die on the table. In less severe forms of infection irrigation will no doubt cleanse the parts as well as if they were removed from the peritoneal cavity, for however executed, the cleansing is more apparent than real, as we cannot hope to free the surface of the innumerable colonies of germs that cling to every portion of the bowel.

The one great advantage that evisceration possesses over mere irrigation is that it enables us to more effectually cleanse the various fossæ of the peritoneal cavity.*

If at the time of the operation there happens to be great distension of the intestines, we should take the opportunity of opening them in various places in the manner we have

* It has recently been suggested that, after opening the peritoneal cavity, the patient should be placed in a bath of sterilized salt solution.

This is a good suggestion, but it is a difficult matter to get a bath sterile. In one instance, after opening a boy's abdomen, we evacuated over a quart of pus. We sewed the peritoneum to the rectus sheath on either side of the wound, and inserted an iodoform gauze drain, and on the following day we removed the gauze, and placed the boy for an hour in a bath of hot saline, so that the fluid flowed in and out of the peritoneal cavity; this treatment was continued each day for a fortnight, and the boy recovered.

In another instance, after removing the appendix, the bowel gave way in the night, and the fæces were discharged through the drainage-tube. This lad was also placed in the bath, and recovered.

In a third instance the abdominal wound was opened on the fourth day, the peritoneal cavity washed out, and a gauze drain inserted. After a few days this patient was also placed in the bath (Fig. 128A) for an hour a day, and she recovered.

In all cases of hydatid cysts treated by Lindermann's method, the patients are placed in the bath as soon as the cyst becomes septic.

The bath we use is on wheels; it is brought to the side of the bed, and the patient is lifted on to a framework, and lowered into the warm water, where she remains for an hour or so.

Besides the bath, continuous irrigation of the peritoneal cavity with normal saline solution at a temperature of 100° F. during seventy-four hours has been successfully tried in one case by Laplace. This treatment could be easily carried out if the patient were placed on the framework of the bath, the irrigating fluid being allowed to very slowly enter by the abdominal wound, and to run out by a vaginal drain, or by drainage-tubes fixed in the loins.

described in the sections dealing with intestinal obstruction, and after emptying the intestines we should inject into the bowel a large dose of sulphate of magnesia.

If the patient has been vomiting 'coffee-grounds,' it is absolutely imperative that a coil of the bowel should be opened and left open. We regard this as an essential part of the operation.

Having completed the cleansing of the parts, we must next take care to provide adequate drainage, for whatever our notions may be with regard to drainage at the end of the primary operation, we may lay it down as a hard and fast rule that drainage is a *sine quâ non* after an operation for septic peritonitis.

Firstly, a large pair of forceps should be inserted into the vagina by an assistant, and pushed up into the posterior fornix, so that the operator may cut on to them with a pair of curved scissors. When the opening is made the assistant pulls the handles asunder, and so enlarges the opening. The operator then inserts a large rubber tube into the projecting jaws of the forceps, and the assistant withdraws the forceps. Above this drain some iodoform gauze is loosely packed into Douglas's pouch, and the end is allowed to project through the abdominal incision. In place of this gauze we may employ a glass or a rubber tube.

But these drains are not sufficient; it is necessary to push a large pair of forceps through the renal fossa on either side, cutting through the skin and muscle from without with a scalpel. Through these openings rubber tubes, or gauze or wick drains may be passed. As, however, the muscles tend to rapidly close on such drains, it is advisable either to sew the peritoneum to the skin, or to insert a short, wide silver tube—in diameter $\frac{3}{4}$ inch, in length $1\frac{1}{2}$ inches—shaped like a straight tracheotomy tube, through which the gauze or rubber tube is drawn.*

Having arranged these drainage-tubes and gauze the abdominal incision may be closed, care being taken not to draw the sides of the wound together in such a complete way as to interfere with the drainage.

Many operators do not close the abdominal incision, as it takes time, and prolongs the anæsthetic. A few safety-pins are of service in controlling a gaping incision. After inserting the

* Extensive drainage after thorough irrigation has given Mayo Robson brilliant results in treating diffuse peritonitis in cases of appendicitis (*British Medical Journal*, December 19, 1896).

gauze drains, the viscera may be covered with a pad of gauze large enough for its edges to extend well beneath the parietal peritoneum for an inch or more from the edges of the wound, the edges of which may be drawn together by a few strips of plaster. There is not nearly so much danger of a prolapse of any of the intestines as one would imagine, for the adhesions created by the peritonitis serves to maintain the coils of the small intestines in a fixed position.

The open wound is now covered by a few layers of gauze and a few thick pads, and the whole is kept in position by a few strips of plaster and a binder.

This outer dressing is changed from time to time as it becomes soaked, but the gauze that is stuffed between the sides and under the incision is not interfered with for two days, when it may be removed, and some of the gauze drains may be withdrawn; but the pad of gauze that protects the viscera should not be removed until the fourth day.

When this pad has been withdrawn, the sheaths of the rectus on either side may be united by a few chromic acid gut sutures, but the skin and superficial fascia must not be united.

This open method has the great advantage of allowing free drainage, but it is almost certain to be followed by an incisional hernia.

After the patient is removed to bed a stimulating enema of carbonate of ammonia should be administered, and if the submammary injection has not been completed on the table, a few ounces of brandy and a drachm of digitalis may now be added to the saline solution.

If the patient rallies and progresses favourably, we may try injections of antitoxin, and give by the mouth dessertspoonful doses of Warburg's tincture—a most excellent drug.

CHAPTER XXXIX

POST-OPERATIVE ADHESIONS AND INTESTINAL OBSTRUCTION

After a cœliotomy we encounter obstruction of the bowels, either in the form of a true ileus, or as a pseudo-ileus. The former is, in the majority of instances, due to the formation of adhesions; the latter may likewise be due to the bowel adhering to a raw surface, but, as we have shown elsewhere, pseudo-ileus is more often due to sepsis and excessive distension of the intestines by gas.

We shall here consider true ileus, due to mechanical causes, and this involves a consideration of the formation of post-operative adhesions; for even if these adhesions do not lead to obstruction, they frequently cause the patient more pain and distress than the original trouble, or cause her to suffer from the most obstinate constipation.

Ward has given the following classification of the etiological factors in adhesive formation:*

Adhesions of peritoneum.
- 1. Sepsis.
  - 1. Virulent. — General peritonitis, with lymph and fibrous exudation.
  - 2. Mild. — In circumscribed areas only sufficient to produce a localized inflammation, with plastic exudate.
- 2. Traumatism.
  - 1. Severe. — *Denuded Areas.* — Adhesive formation by the natural process of repair.
  - 2. Mild.
    - 1. Excessive manipulation of parts.
    - 2. Desiccation from dry-air contact.
    - 3. Cold.
    - 4. Chemical irritation from antiseptic solution.

    Cause.— Pseudo-ileus and necrosis of endothelial cells.

* Ward, *American Journal of Obstetrics*, 1901, vol. xliii., p. 764.

TOPOGRAPHICAL ANATOMY OF ABDOMINAL VISCERA.

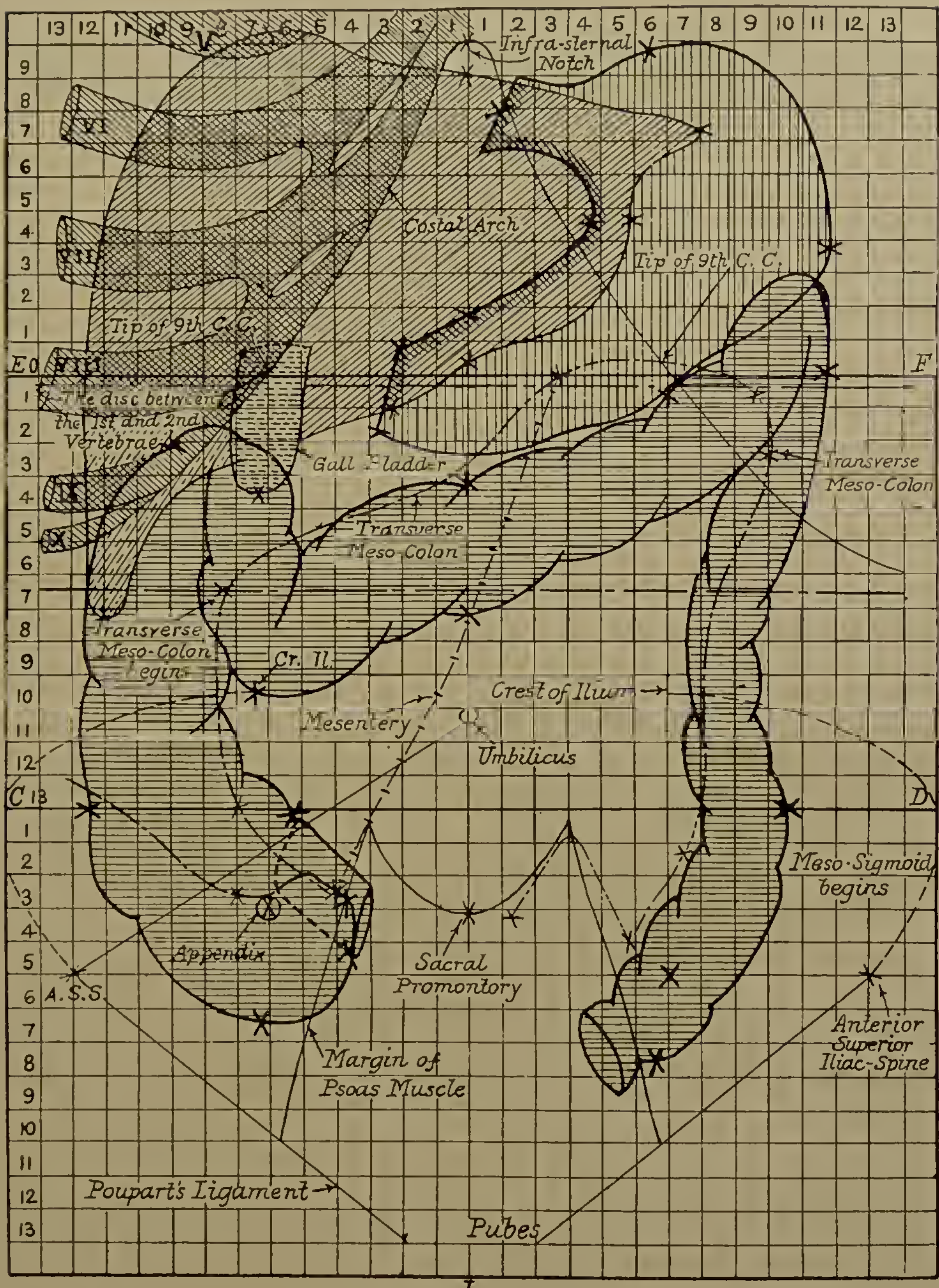

PLATE IX.

From *Progressive Medicine.*

(*Lower Border of Stomach and Upper Border of Transverse Colon should be* 0·5 *cm. lower.*)

To face p. 416.

Ward says: 'We may classify these causes under two heads—namely, sepsis and traumatism.

'When there is sepsis it may be virulent or mild in character. If virulent, we have the adhesions formed as a result of general peritonitis, with lymph and fibrous exudation. If mild, it may be in circumscribed areas, only sufficient to produce a localized inflammation with a plastic exudate.

'If traumatism is the factor, we may also have a severe or mild type. If severe, we have denuded areas, in which the peritoneum has been stripped or destroyed in enucleating growths, or breaking up pre-existing adhesions, leaving raw surfaces. In this type the adhesive formation is by the natural process of the repair of tissues by the proliferation of cells, and the formation of a network of bloodvessels between the opposing surfaces.

'In the mild type of traumatism we have necrosis of the endothelial cells, which, according to Kelterborn, do not reform when destroyed. This mild traumatism is generally microscopic in character, although it may be noted in many instances by the loss of the glistening appearance of the peritoneum. The formation of adhesions in this class of cases I believe is also by the throwing out of exudate in Nature's efforts at repair.

'This necrosis of endothelial cells may be brought about in several ways. Excessive manipulation of the serous surfaces, as is necessitated in prolonged or difficult operations, is a frequent cause. Chemical irritation from the use of antiseptic solutions in the abdominal cavity is a cause; but fortunately, at the present day, their use is rare, except when peroxide of hydrogen is used.

'Desiccation of the peritoneum from the effects of dry-air contact, as shown by Walthard, is a frequent and potent factor in the death of the superficial cells.

'Cold induced by the action of dry-air contact, and the lowering of the natural heat of the peritoneal cavity by prolonged exposure, causes a contraction of the capillaries, and a subsequent death of the endothelial cells of the peritoneum; and, as pointed out by Turck, the lowering of the temperature causes a loss of the resisting power of the peritoneum to the attack of micro-organisms, which it might successfully resist if the heat were kept up.

'We may lay down the statement that the formation of peritoneal adhesions after operations is directly proportionate to the amount of sepsis, traumatism, dry-air contact, loss of heat, and raw surface there is present.'

Frequency.—Intestinal obstruction is by no means a rare complication after cœliotomy.

Rohé has collected 75 cases where death was due to this cause.

Spencer Wells lost 11 cases from ileus in his first 1,000 cases of abdominal section.

Klotz, in a series of 421 sections and 148 vaginal hysterectomies, reported that there were 31 cases of intestinal obstruction with 5 deaths.

Winternitz found, in Doederlein's clinic, that in three years there were 11 instances of post-operative ileus after 837 intraperitoneal operations. Five of these cases occurred in 280 vaginal total extirpations. Etiologically, 3 cases were due to sepsis, 7 were instances of true mechanical obstruction, and 1 was paralytic ileus. Of the 7 cases of true ileus, 6 were saved by a second operation and 1 died, but none of the septic cases were saved.

Dr. May Thorne* has gathered together statistics to show the periods at which intestinal obstruction occurs after abdominal section.

1 case	occurred	14 years	after the	original	cœliotomy.
1 case	,,	5 years	,,	,,	,,
3 cases	,,	4 years	,,	,,	,,
1 case	,,	1 year	,,	,,	,,
1 case	,,	6 months	,,	,,	,,
2 cases	,,	2 months	,,	,,	,,
1 case	,,	15 days	,,	,,	,,
1 case	,,	11 days	,,	,,	,,
1 case	,,	10 days	,,	,,	,,

Greig Smith considered that 2 per cent. of all deaths after cœliotomy were due to intestinal obstruction.

Cases illustrating Intestinal Obstruction.

Since ileus may be due to many mechanical conditions, we shall get a more accurate idea of these various forms by con-

* *British Medical Journal*, February 4, 1899.

OUTLINES OF THE DEEPER ABDOMINAL VISCERA.

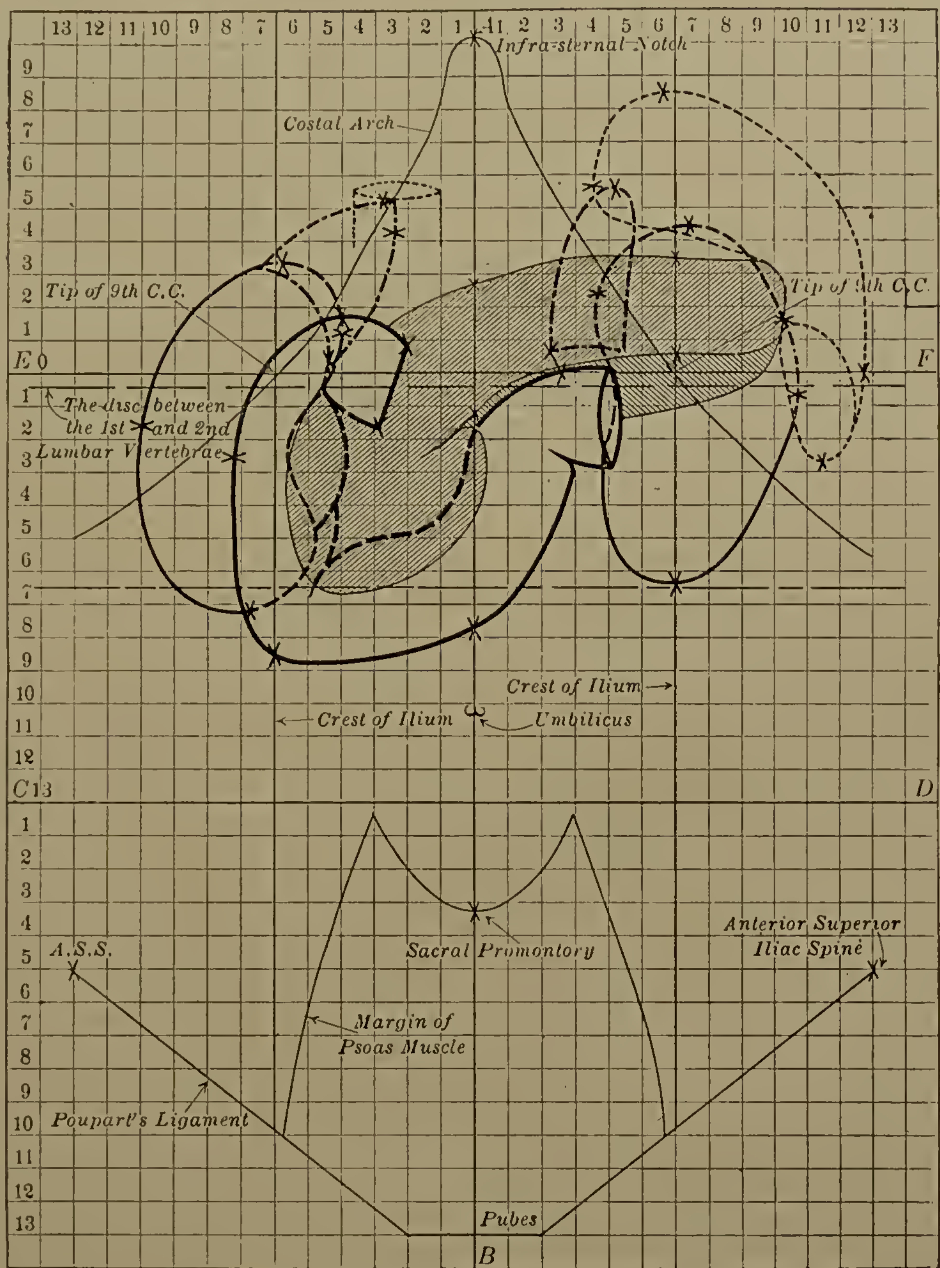

PLATE X.

From *Progressive Medicine.*

To face p. 448.

sidering the reports of actual cases rather than by enumerating the classical symptoms detailed in text-books.

1. **Ileus caused by the Adhesion of the Bowel to the Pedicle.**—The bowel in these cases may adhere to the stump left after the removal of an ovarian cyst, or after extirpating the appendages, and Greig Smith has drawn attention to the fact that removal of the uterine appendages for myoma would seem to have an undue proportion of deaths from ileus, due to the adhesion of the gut to the pedicle.

Phillips* records a case where, a year after the ovaries and appendages had been removed for menorrhagia, the patient was seized with severe pain and sickness, and her temperature rose to 102° F.; there was much abdominal pain and constant vomiting, the bowels were confined, the abdomen not distended, but there

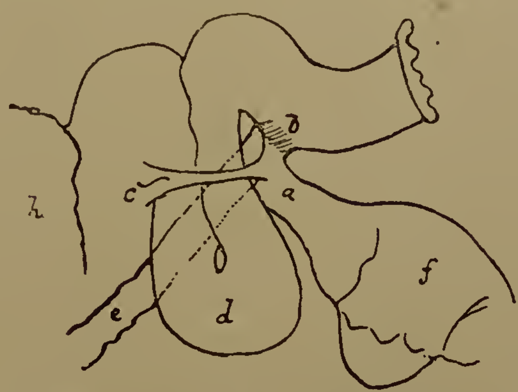

FIG. 129.—Ileus caused by Adhesion of the Bowel to the Pedicle.

was great tenderness, and some fulness over the region of the cæcum. She was treated by rectal injections. The temperature became normal, sickness ceased, and the bowels acted; the pain and tenderness over the cæcum and right side of the abdomen, however, continued. Ten days from the commencement of the illness the bowel acted freely, but instead of giving relief the act was followed by aggravation of all her symptoms. The temperature fell to subnormal, and she died exhausted, in great pain, after sixteen days' illness.

Post-mortem Examination.—On opening the abdomen no general peritonitis was found. The appended figure (Fig. 129) will give some idea of the arrangement of the parts. From the right uterine stump (*a*) to the small intestine (*c*), just before its

* *Lancet*, September 10, 1892.

entrance into the cæcum (*h*), a thick adhesion, $1\frac{1}{4}$ inches long, was found extending; it was broader at the intestinal end, and thinned off to a point at its insertion into the uterine stump. Immediately below this was a knuckle of small intestine 8 inches in circumference (*d*), dark and congested, but not of a chocolate colour. Beneath the intestine again was found the vermiform appendage (*c*), much thickened, and $3\frac{1}{2}$ inches long; it was in a condition of almost extreme tension; its distal extremity was attached, just above the uterine stump, to the small intestine, and peritonitis was commencing there (*b*).

Wells removed a large multilocular ovarian cyst from the right side; the state of the patient after the operation was unsatisfactory from the first, but there was not much pain. Some sickness on the day after operation increased on the second day, and the abdomen became tympanitic. On the third and fourth days the vomiting continued, and a great deal of dark-green or coffee-coloured fluid was thrown up. A free fluid motion was followed on the fifth and sixth days by some improvement, although the vomiting of large quantities of greenish fluid continued. On the seventh morning the patient appeared much better, but in the evening the pulse was 160, and she appeared almost moribund. Five grains of quinine were given every three hours by mouth and rectum. In sixteen hours 35 grains had been given, and on the eighth day the pulse had fallen to 120. In the next ten days she improved in many respects. There was no vomiting, but she suffered at times with abdominal pain and much flatulence. On the nineteenth day she appeared remarkably well, but at night, after a free watery motion, she suddenly became faint and sick, and died on the morning of the twentieth day.

The wound was found firmly united. There were scarcely any traces of general peritonitis. No intestine was adherent near the wound, but one coil was slightly adherent above the umbilicus. The pedicle of the tumour of the right ovary was closely surrounded by an adhering coil of the ileum, just before it enters the cæcum. About an ounce of pus was circumscribed by this adhering intestine around the end of the pedicle, so that none of the pus entered the peritoneal cavity. The canal of the adhering coil of intestine was almost completely obstructed, partly by the sharp curves at which it was fixed, and partly by the contraction of the adhering portion, the intestine above

being much distended. There was neither blood, lymph, nor serum in the peritoneal cavity.

2. **Adhesion of Bowel to both Pedicles.**—The bowel may adhere to more than one spot. Thus, Leopold reports a fatal case of obstruction due to adhesion of the colon to the stumps of both pedicles left after bilateral ovariotomy; the bowel was quite impermeable in both situations.

3. **Adhesion of Bowel to the Abdominal Cicatrix.**—Malcolm* reports a case where, on account of symptoms of chronic obstruction, he reopened the abdomen twenty-two months after the appendages had been removed. He found that the centre of the transverse colon was fixed to the back of the abdominal incision, nearer to the pubes than to the umbilicus, so that the portion of the colon was **V**-shaped, and the acute angle at the middle of the colon was at the time of the operation occupied by a scybalous mass of fæces.

4. **Adhesion of Bowel to the Abdominal Wall.**—Treves says a specimen (No. 2,692) in the Museum of the Royal College of Surgeons shows a coil of small intestine adherent to the abdominal wall, and very sharply bent at the point of adhesion. The specimen was from the body of a woman, aged forty-five, who four days after ovariotomy developed symptoms of acute obstruction, of which she died in three days.

5. **Adhesion of the Bowel to a Raw Surface left after Removing the Tumour.**—Anderson and Hanfield-Jones† record a case where, seventeen days after removing a fibro-sarcoma of the right ovary, vomiting set in, which three days later became stercoraceous. On the twenty-first day after the operation the notes say that the patient is much emaciated, she has lost much flesh and strength during the past week, the eyes are sunken, and large dark rings surround them. There has been no action of the bowels (for some days). Tongue moist, not coated; the abdomen is distinctly tympanitic, resonant everywhere, soft and supple, not tender, and moves fairly with respirations.

After opening the peritoneal cavity it was found that a knuckle of the upper portion of the ileum had become firmly fixed, by adhesive peritonitis, to the wall of the cavity, just above the position of the cæcum, the spot having been rendered raw and bare by the tearing away of an adhesion with a broad base during the process of removing the growth. So broad and firm

* *Lancet*, October 16, 1897. † *Ibid.*, November 2, 1889.

was the union between the bowel and the parietes that it was necessary to dissect off the parietal peritoneum, and set the gut free with the adherent portion of the latter attached to it. The patient recovered.

6. **Obstruction by means of Adhesions that Compress the Gut.**—Malcolm* performed a double ovariotomy on a patient, and the operation was followed by troublesome constipation, which became a serious difficulty ten years later. When examined the finger in the rectum could not reach the seat of obstruction, but large masses of fæces were felt both through the rectum and through the vagina, and also by palpation of the abdomen. The abdomen being opened, the whole colon was found enormously distended, but the cause of the obstruction was not found. The sigmoid was sewn to the abdominal wound, and it was opened late on the day of the operation, but death occurred soon after. The autopsy showed that at the lower end of the sigmoid flexure the canal of the gut was almost completely obstructed by a mass of cicatricial tissue; the lumen of the canal was reduced to the size of a cedar pencil, and passed obliquely through the diseased tissues.

In one of Olshausen's cases death occurred from obstruction on the sixth day. The autopsy showed that the colon was firmly clasped by the omentum, and was markedly stenosed.

7. **Obstructions caused by Bands.**—Macready† operated on a woman who suffered from colicky pains, which had been present more or less continually after an ovariotomy, which had been performed seven years previously. Two years after the first operation the patient had total obstruction for fourteen days, which yielded to palliative treatment. After a second attack of obstruction Macready opened the abdomen, and found four deep adhesions, and another still deeper adhesion, constricting the intestines by passing from one loop to another. These were divided, and the patient recovered.

8. **Obstruction by Acute Kinking due to Traction.**—Meredith‡ operated on a feeble woman, aged fifty-eight, for double ovarian cystoma complicated by very extensive adhesions. During the second week, the patient, who had been progressing satisfactorily, complained of nausea, and soon after vomited a quantity of dark-green fluid. The abdomen then became fuller,

* *British Medical Journal*, vol. ii., 1888, p. 816.
† *Lancet*, September 10, 1892. ‡ *Ibid.*, April 3, 1886.

and the urine was found laden with albumin. The abdomen was reopened, and the peritoneum was found intensely red and congested, evidently in an early stage of acute inflammation. Attention was attracted by a coil of greatly distended small intestine, which was badly kinked and obstructed in consequence of the traction exerted upon it by a portion of the ligated omentum, which was closely adherent to its surface. Another coil was found obstructed by a separate omental band. The acute symptoms were at once relieved, although 'no evacuation of the bowels took place until the twenty-third day, when fæcal matter was for the first time detected in the rectum, and relief followed upon the use of the enema.'*

9. **Obstruction from a New Growth.**—In a case operated on by Malcolm,† from which an ovarian cyst had some months previously been removed, the obstruction was found to be due to a neoplasm springing from the posterior abdominal wall, just above the lower end of the ileum. Target‡ removed bilateral ovarian tumours, and noticed that on the surface of the right tumour there were soft nodules of growth, and similar deposits were observed on the omentum and mesentery. Six months later the patient returned to the hospital with extreme distension of the abdomen. She had had attacks of diarrhœa, and lately the bowels had not acted well, and for four days there had been complete obstruction. A large mass was felt behind the uterus. Cœliotomy was performed, and the patient lived three weeks. At the autopsy it was found that the surface of the intestines, omentum, and mesentery was studded with small discs of new growth. On the right side a coil of ileum was adherent to the pouch of Douglas below the ovarian pedicle, and this adhesion had caused obstruction by kinking of the ileum about 10 inches above the ileocæcal valve. The sigmoid flexure was closely coiled up behind the uterus, and adhered to it by

* Adenot and Jaboulay have pointed out that, after removing a large abdominal tumour, we may get ileus from obstruction at the splenic flexure of the colon. This occupies a higher plane than the hepatic flexure, and the bowel is suspended by the mesentery, which is fan-shaped. Occasionally, however, the fan-shaped piece of mesentery is reduced to a single cord, inserted just on the superior angle of the splenic flexure. When the tumour is removed the transverse colon descends, and this causes the angle at the splenic flexure to become more acute, and ileus results (Lejars).

† *Lancet*, vol. ii., 1891.

‡ *Transactions of the London Obstetrical Society*, vol. xl., p. 175.

growth. In the rectum, about the level of the cervix uteri, there was a large mass of growth which had surrounded the calibre of the bowel, and by fungating into its lumen had caused a second obstruction. The possibility of a third obstruction existed, for the transverse colon was drawn down to the pelvis by four adhesions of the great omentum to the pelvic organs.

10. **Obstruction due to Strangulation through Slits.**—Howard Kelly operated on a case with pelvic peritonitis and with a cystic ovary and tube bound down by firm adhesions. The next day she complained of much pain in the abdomen, and slight nausea. Two days later pain and distension, but the bowels moved slightly. On the sixth day vomiting; abdomen greatly distended in epigastric region; tongue red, dry, swollen; much thirst and griping pains. On the eleventh day almost constant pain, with frequent paroxysmal attacks not definitely located. Large fluid bowel movement. On seventeenth day abdomen opened above umbilicus, exposing greatly distended small intestines. Tense band found on left side, cutting across bowels and extending down to the left kidney. The patient died on the twenty-second day, and the autopsy revealed a loop of intestine 10 inches from the ileocæcal valve projecting through an omental hole.

In Spencer Wells's seventeenth operation the patient exhibited signs of obstruction, and the abdomen became greatly distended, and the patient died after vomiting green masses. The autopsy showed that a loop of small intestines had become incarcerated in the space between the fundus uteri, the pedicle, and the abdominal wall.

11. **Obstruction due to Volvulus.**—Olshausen states that Billroth regarded torsion of the axis of the gut, due to displacement during the operation, as the most frequent cause of intestinal obstruction. He, however, remarks that the literature of the subject does not bear out Billroth's opinion, recording, however, the fact that one of his own cases died, a year after operation, of volvulus.

Blume,* after performing vaginal hystero-salpingo-oöphorectomy, had to open the abdomen during the third week for obstruction. Two distended coils of the ileum appeared in the abdominal incision, one of them being rotated more than half-way about its longitudinal axis—partial volvulus—and kept in

* *American Journal of Obstetrics*, vol. ii., p. 634, 1899.

this position by several firm bands. As soon as these bands were cut between ligatures the collapsed portion of the bowel below the constriction became distended.

Shively* reports the case of a woman who had had an ovariotomy performed. For five years she had suffered from colicky pains, and after seven days' illness she died. The autopsy showed extensive adhesion among the intestines. A portion of the ileum 18 inches above the cæcum was adherent to, and incorporated with, the cicatrix of the wound of the previous ovariotomy. Around the short portion between this and the cæcum a loop of small intestine was twice twisted, forming a kind of knot, and a complete occlusion was thus produced.

Montgomery, in his recent text-book (p. 782), mentions a case of volvulus which occurred after an ovariotomy. 'The abdomen was reopened, and 5 feet of intestine were torn up, disclosing a distinct volvulus, which was untwisted.' The patient recovered.

12. **Obstruction due to the Bowel being caught in a Ligature or Suture.**—Wells mentions a case in which a loop of the intestine was included in one of the abdominal sutures, and thus compressed.

Greig Smith remarks: 'The gut has been caught in the pedicle ligature of an ovarian tumour, and under the wire constricting a uterine pedicle.'

Harrison Cripps performed hysterectomy. The abdomen was closed in the usual way, but in tightening one of the lower silk-worm gut sutures it gave way, and by means of a Hagedorn needle, and with a finger passed in as a guide, another was put in its place. She continued to do fairly well until the third day, when towards the evening there was vomiting. All nourishment was stopped by the mouth; she was fed by nutrient injections; temperature normal, and pulse 70. On the fourth day there was some slight distension at the upper and left side of the abdomen, but no tenderness; the patient's face had an anxious expression, but the pulse was of good volume, and 80. There was no sickness during the day, but towards evening she vomited 6 ounces of dark fluid. The following day the pulse had increased to 90; the distension had not increased; there was again no sickness until the evening, when she vomited once, bringing up 6 ounces of dark fluid. She did not vomit again for twenty-four hours, when she vomited a considerable quantity of fluid with a

* *New York Medical Journal*, vol. xl., p. 292, 1884.

distinct fæcal odour. The pulse had now increased to 110, and showed some loss of power. The abdomen was slightly more distended than the day before, but even now it was nothing to speak of, and mostly unilateral. On the evening of the eighth day the vomiting recurred, and was almost continuous during the night. The pulse failed rapidly, and she died on the morning of the ninth day.

An examination after death showed that the wound had healed with the exception of 1 inch above the pedicle. On cutting the stitches the wound separated with moderate pressure of the finger. About two-thirds of the small intestines were distended; the remaining portion was empty, and contracted to the size of the little finger. A portion of the empty intestine was firmly adherent at a point not covering more than $\frac{1}{6}$ inch in diameter at $\frac{1}{4}$ inch from the middle line of the scar, and about the centre of the wound. The adhesion, though small, was extremely firm, and it required some pressure of the finger-nail to separate it. Again, 2 or 3 inches below, the same coil of intestine was slightly adherent to the uterine stump; the effect of this double adhesion was to kink the bowel. This was obviously the seat of the obstruction, for down to this point the intestine was dilated, beyond it was contracted. Cripps says that he could not help thinking that the adhesion to the peritoneum was produced by the stitch mentioned as having been introduced in the place of the broken one.

13. **Obstruction due to Traction on the Utero-sacral Ligaments.**—Christopher Martin says that in cases of supra-vaginal hysterectomy (for myoma) the cervix is dragged forwards into the wound by the transfixion pins. The utero-sacral ligaments, which pass backwards from the cervix and embrace the rectum, are dragged on. If there be great tension on the stump, these ligaments will tightly constrict the rectum, even to the extent of producing total obstruction.

Martin also calls attention to the fact that the formation of a large extraperitoneal hæmatocele in the left broad ligament may cause obstruction by encircling the rectum.

14. **Gastric Obstruction after Laparotomy.**—Von Herff* finds that ileus, after operation, may be caused by extreme distension of the stomach. The abdomen swells to a great size,

* *Centralbl. f. Gynäk.*, No. 40, 1899; *British Medical Journal*, Epitome, 256.

and the outline of the stomach can be traced in many cases; it sometimes touches the pelvic inlet. On washing out the stomach great quantities of transuded fluid come away. The stomach-pump is of service when there is atony of the gut. This extreme distension of the stomach causes kinking of the duodenum.

Symptoms of Acute Obstruction.

The symptoms which we shall be called upon to deal with will depend on the period that has elapsed since the operation.

As we have seen from the cases enumerated above, the symptoms may set in during the first days that follow after the operation, or the symptoms may not occur for years afterwards.

Of the forms of obstruction enumerated above, the one that most frequently occurs and gives rise to alarming symptoms during the first weeks that follow the operation is due to acute kinking of the bowel. This may be brought about either by a band attached to the free border of the intestine pulling on it, whereby it becomes acutely bent, or it may be due to the intestine adhering to a raw surface, such as a pedicle, or a spot on the abdominal wall, where it becomes immobile and kinked.

When the symptoms of obstruction occur during the first week, we shall be at a loss to decide whether we are dealing with a case of paralytic ileus, peritonitis, or true obstruction. This is well illustrated by the following case recorded by Malcolm, which gives us an excellent picture of early obstruction. 'After the operation there was little pain, and no opium was given. On the following morning there was distinct abdominal distension, which was much more marked towards evening. Flatus, which had been escaping through the rectal tube at intervals, now ceased to pass. I ordered ½ drachm of sulphate of magnesia, with 10 grains of the carbonate every hour, and six doses were given. After this there was a free escape of flatus from the rectum, whenever the rectal tube was inserted, till three o'clock next morning, and also at 9 a.m. Notwithstanding this the abdominal distension rapidly increased. On the afternoon of the second day the saline aperient was again given in repeated doses, but no more flatus escaped downwards. Towards evening vomiting commenced, and soon became continuous. The temperature slowly rose to 104° F. in the vagina, the pulse to 154, and the patient died at 4 a.m. on the third day after the operation. It was found after death that a coil of small intestine was

adherent to the divided tissues of the right broad ligament. The bowel was here acutely bent. It was immensely distended above the adhesion, but completely collapsed below it. . . . Before the post-mortem examination, however, it was confidently asserted by some that the patient had died from acute peritonitis. The case therefore proves that symptoms resembling those of peritonitis may be due to obstruction of the bowels.' *

Should the case be one where the intestine has been caught in a ligature or by a suture, the symptoms are those of acute strangulation from the outset, but these cases are excessively rare.

The most common instance that we meet with is one in which the patient has progressed well for the first few days. About the fourth day the wind begins to get troublesome. There is some pain, and the pain is often very severe, coming and going in paroxysms, being chiefly due to the increased peristaltic action of the bowel above the seat of obstruction. If purgatives or enemata have been given the bowel may act once or twice, and some gas may be expelled if the obstruction is in the small intestine; but in spite of all our efforts the bowels do not move satisfactorily, and the expulsion of gas is not followed by an amelioration of the patient's condition, as we find in many instances of pseudo-ileus.

The vomiting now increases, and becomes the prominent symptom, being associated with much retching and distress, everything taken by the mouth being almost immediately rejected. The vomited fluid is expelled in large quantities, and changes from bile-stained fluid to the dark coffee-coloured fluid, and then it may become stercoraceous.

The pulse remains rapid, soft, and often thready. The temperature will probably be about 100° F., but if peritonitis sets in early the temperature will be higher.

The respirations are superficial, but not embarrassed.

The tongue during the first days may have remained moist, but it acquires a coat, and then becomes dry, sometimes brown, at other times bile-stained.

The patient always complains of thirst.

The urine may contain albumin, and it is always diminished in quantity. It may contain indican in large quantities if the obstruction is in the ileum.

* Malcolm, *Lancet*, vol. ii., p. 120, 1891.

Examination of the abdomen shows us that pressure does not cause the intense pain that we get in a case of peritonitis. Tympanites is not marked; at first we get some distension about the epigastrium and umbilicus, but as the case progresses the whole abdomen becomes distended, especially towards the conclusion of the case if peritonitis sets in.

As the case progresses, the vomiting, hiccough, and retching become very intense, and the patient's face assumes a look of great distress, and her whole appearance gives one the idea of collapse. If the patient is not operated on, the bowel may give way, or the patient may die of peritonitis or intestinal septicæmia, or the bowel may become more and more distended until the patient dies in a condition similar to pseudo-ileus. The duration and termination will depend on the presence or absence of septic complications, and on the condition of the patient at the time of the operation. Elderly women, and those already enfeebled by long illness, succumb during the first week, while the more vigorous may live on for some weeks if the obstruction is not complete.

Diagnosis.

When symptoms of obstruction appear during the first week, we must differentiate between ileus, pseudo-ileus, and peritonitis. To do this is sometimes impossible, for ileus and pseudo-ileus may both be accompanied by peritonitis; peritonitis may exhibit all the signs and symptoms of ileus; lastly, many cases of pseudo-ileus depend on adhesion of the bowel to a small area.

In endeavouring to form a differential diagnosis the following points may be borne in mind:

In **pseudo-ileus** the symptoms set in earlier than in true ileus; pseudo-ileus, in fact, occurs almost invariably during the first week from the third to the sixth day. The vomiting is not so persistent, and does not become stercoraceous. The patient is often quite calm. If we get flatus to pass by the rectal tube, or if the bowels act after an enema, the patient's condition improves at once. This is in marked contrast to true ileus, where little flatus passes, and the bowels are never well relieved, the small motion due to the emptying of the colon giving no relief whatever.

The pain in pseudo-ileus may be somewhat colicky at the outset, but it never continues to be paroxysmal; the pains,

in fact, tend to disappear as the bowel dilates and becomes paralyzed. In true ileus it is localized at first, then general, and usually persistent to the end. Pseudo-ileus runs a rapid course, and death occurs before the seventh day; in true ileus the symptoms seldom begin until the end of the first week, and the patient lingers on until the tenth day or even longer.

In those cases where the pseudo-ileus is due to a small area of bowel becoming adherent, no distinction can be made between the condition and true ileus, and none is necessary.

In **peritonitis** the patient is quiet, and almost invariably lies from the outset with her legs drawn up in bed to protect and relieve her tender abdomen; this attitude is not characteristic of obstruction, for the crampy pains of the increased peristaltic movements of the bowels cause the patient to move about in bed.

The temperature in peritonitis which follows operations on the pelvic organs shows a gradual rise day after day; but in cases of obstruction uncomplicated by peritonitis the temperature may show no tendency to rise beyond 100° F. Pain is always present in peritonitis, and when the disease is well advanced any pressure on the abdomen causes the patient agony. But in obstruction we do not get this excessive tenderness, and there are times when we can palpate the abdomen without causing the patient much inconvenience, though her paroxysms of pain occur up to the last stages, while in peritonitis the pain may disappear entirely.

In both peritonitis and obstruction the vomiting is a marked feature; but it is rare for the vomit to be stercoraceous in peritonitis, unless the patient has survived several days. Again, the vomited matter in ileus is usually more copious. The bowels may act in peritonitis; in fact, they may act several times during the first week, and yet the patient may be in the last stage of peritonitis. In obstruction the absolute constipation is one of the most striking features.

In peritonitis the tympanites is marked from the first, and is diffused, while the abdomen becomes drumlike; in obstruction the tympanites may be localized at first.

Jeanne* insists on the importance of two special signs in distinguishing between intestinal occlusion and acute general

* *Bull. et Mém. de la Soc. de Chir.*, February 13, 1900; *British Medical Journal*, Epitome, 207, vol. i., 1900.

peritonitis. In the latter condition he states that there is extreme sensibility of the recto-vesical or recto-uterine sac, while in the former intestinal contractility persists in a more or less exaggerated degree.

Tuffier, in a report on this paper, states with regard to the first of these signs, that though it does not possess a constant and absolute value, in actual practice it serves, when present, to give much help in cases of difficulty, and ought in such cases to be systematically tested. The peritoneal fold in question is that portion of the serous membrane which is most accessible to digital exploration, and the cul-de-sac receives the infective secretion from other parts of the inflamed peritoneum, and is usually involved in the inflammatory process. Intestinal contraction, manifesting itself by vermicular movements of distended loops which can be traced under the abdominal wall, as it is caused by the effort of the intestine to overcome an obstacle, and is absent in cases of infective inflammation of the peritoneum, favours the diagnosis of mechanical obstruction. It may, however, fail to show itself in such cases; and thus, though it be a valuable sign when present, its absence cannot be regarded as conclusive.

Symptoms of Chronic Obstruction.

The cases which we have given above will sufficiently point to the main features that attract attention in those instances in which the obstruction does not show itself until some weeks, or months, or years have passed by since the operation was performed.

Usually the patient complains of abdominal pains, more or less ill defined, but sometimes referred to one spot in particular, such as the neighbourhood of the pedicle. She often has considerable difficulty with her bowels, and she finds that it takes very large doses of medicine to move her bowels, and as the medicine always causes her great pain, she often neglects the bowels rather than go through the agony of having them moved.

In some cases almost complete obstruction may occur for a week or more, after which the bowels will act, and the patient will then be quite well for a time. This state of things continues until some intercurrent disorder causes the patient to exhibit the signs of acute obstruction.

Treatment.

Prophylactic.—Since there is such a wide divergence of opinion with regard to the etiological factors concerned in the production of post-operative peritoneal adhesions, we can only offer tentative suggestions with regard to the prevention of ileus.

We should release all adhesions of the small intestine about the field of operation which bind it in such a way that kinking may be possible, or which hold it down and immobilize it.

Besides attending to bands and adhesions, we must not leave large denuded surfaces uncovered; if possible, we may cover these, as Senn suggests, with grafts of omentum, or brush these surfaces, as August Martin does, with sterile olive oil applied by a large sponge. Morris believes that aristol is capable of forming a protective covering; but we think that Stern's suggestion that collodion should be used is absurd.

The end of a broad pedicle should always be covered by sewing the peritoneal coat over it by a continuous suture, while the mushroom pedicle should be conspicuous by its absence.

Blood-clot should be removed when possible, because it is capable of becoming organized, and so forming adhesions between adjacent surfaces; and Klotz has shown this to be a distinct cause of intestinal obstruction.*

As the occurrence of sepsis is a potent factor in the formation of adhesions, the employment of a rigid aseptic technique, and the abandonment of antiseptic irritating solutions and the drainage-tube, are all measures to be considered in connection with prophylaxis.

Whether **moist** or **dry** asepsis should be employed is a point upon which the most successful operators differ.

The elaborate experiments of Walthard, of Berne, show that prolonged contact of dry air with the peritoneum causes a necrosis of the superficial cells of the serosa by cooling, and this change predisposes the affected area to form adhesions. He therefore strongly advocated **moist** as opposed to **dry** asepsis; we agree with his views.

Sänger, of Leipsig, adopted Walthard's views concerning moist asepsis, and Schiffer, his assistant, reported better results than with dry asepsis. Uhlmann, assistant to Zweifel, of Leipsig, however, states that no apparent benefit has been observed in

* *Centralbl. f. Gynäk.*, No. 29, 1892.

Zweifel's clinic, who prefers the dry method because it is superior as a hæmostatic.

Probably of much more importance than the employment of a moist, as opposed to a dry, technique is the adoption of measures to prevent unnecessary exposure of the tissues and unnecessary handling of the intestines, while rapidity in operation must be a very important factor.

While the Trendelenburg position aids in enabling us to move the intestines from the field of operation, it is of great importance that the coils of intestine thus dislocated and disarranged should be restored to their normal position again.

Malcolm was one of the first to point out how well the employment of irrigation was able to do this.*

Kelly says that the last steps before closing the abdomen are: First, to lift the small intestine out of the pelvis, and place in the pelvis the rectum and any redundant sigmoid flexure, so that if any adhesions form they will neither produce discomfort nor interfere with function; and, second, to see that the small intestines are arranged in the lower abdomen beneath the omentum without any twisting on the mesentery.

By drawing the omentum down over the intestine we prevent adhesion of the bowel to the abdominal wound.

Operative.—Once we are sure that we are dealing with a case of obstruction of the bowels, only one thing remains to be done—to reopen the abdomen. But at the outset we shall be far from certain, for the symptoms of beginning acute obstruction have little or no diagnostic character. We are aware that the visceral nerves are being irritated and excited, but time must elapse before the clinical picture is sufficiently developed to allow of a differential diagnosis.

During this period of uncertainty we may merely content ourselves with being 'masterly inactive,' or we may administer sedatives or purgatives.

The administration of purgatives after cœliotomy has, at the present time, become such a general practice that little or no attempt is made to distinguish between those cases which are distended, and in which peristalsis has almost ceased, and those

* 'The advantages gained by washing out the peritoneal cavity seem to me almost to depend mainly on the effectual way in which the process insures a natural disposition of the intestines, and a consequent immunity from obstructive troubles, even if adhesions should take place' (*Lancet*, July 25, 1891).

cases which are also distended, but in which the patient is troubled with intense colicky pains, due to increased, but fruitless, peristaltic waves.

That the purgative treatment, as opposed to the opium after-treatment, after section cases is more successful is shown by its universal adoption, and in 97 per cent. of cases it is undoubtedly the correct treatment to adopt.

There remains, however, 3 per cent. of cases in which there is obstruction of the bowel present, and in the majority of cases the obstruction is due to a kink in the bowel. That this kinking may take place as the result of inflammation, paralysis, or the adhesion of a short section of bowel to a fixed surface, no one now doubts, and it occurs after laparotomy more frequently than in 3 per cent. of cases. The condition leads to no serious results now that purgation is the rule; but when opium was extensively used after cœliotomy deaths from intestinal obstruction were much more common.

Yet the gynæcologist's method of dealing with obstruction is apparently opposed to the tenets held by the general surgeon; for the former purges his patients when they exhibit signs of obstruction, while the latter holds that 'under no circumstances whatever should any aperient or purgative be given in a case of acute intestinal obstruction' (Treves). The gynæcologist's practice is correct, because the majority of cases of obstruction met with after operations in the pelvis being due to kinking, from the bowel adhering, he believes that strong peristaltic action may be sufficient to free the bowel from its newly-formed adhesion. There is nothing illogical in this, for Walthard found in his experiments 'that the force of peristalsis is sometimes sufficient to detach a silk suture uniting the sides of two coils of intestines.'

While we admit that the above treatment with purgatives will prove most satisfactory as a routine practice, we must point out that if we encounter a case where, on the sixth or seventh day, we have frequent colicky pains with distension, and the patient is passing no flatus and having no movement of the bowels, it is highly probable, especially if the bowels have acted once or twice since the operation, that we are dealing, not with a case of pseudo-ileus, but with a case of kinked bowel, producing mechanical obstruction. To persist in the administration of purgatives, if we find that the peristaltic movements of the bowel

are violent but fruitless, would then be a grave error. We should only exhaust the bowel by further exciting the already violent peristaltic movements. In such a case the administration of a small injection of morphia may be quite efficacious in relieving all signs of obstruction.

Treves, writing from the point of view of the general surgeon dealing with cases of acute obstruction, says of morphia that 'it restores for the time being a state of peace within the disturbed abdomen. The disordered peristaltic movements which are associated with the onset of the attack are brought to rest, and the symptoms due to reflex nerve disturbance are reduced to temporary insignificance.

'Thus it happens that under the influence of the drug the vomiting may cease, or become quite trifling, and the source of disturbance within the belly cavity may almost vanish.

'The part that disordered and excessive peristaltic movements may play in the production and aggravation of certain forms of acute obstruction makes it most desirable that these movements should be checked as soon as possible. A coil may be lightly held beneath a loose band, but under the influence of violent peristalsis in the adjacent loops a larger amount of intestine may be drawn beneath the now tense cord, and strangulation of a severe type be produced.'*

The following case recorded by the Keiths, although an instance of chronic obstruction, yet shows the excellent effect that morphia may have when dealing with partial obstruction: The case was one in a thin subject, and the bowel was observed to be adherent to an enlargement of the kidney. Whenever food was taken peristaltic action was set up, and the bowel could be easily seen distending downwards until it came to the adhesion; here it stopped, an obstruction due to an angle having formed, and if nothing were done vomiting came on. A small dose of morphia invariably gave relief, and the flatus could be seen and heard to pass through the obstruction with a gurgling sound.†

Malcolm, in dealing with the question of sedatives and purgatives, gives the following as his views:

'Treatment by opium or belladonna and rest is often successful in the first few days after an operation when flatus does not pass freely downwards, and when there is slight irregular distension

* 'Intestinal Obstruction,' p. 451.

† Keith, 'Text-book of Abdominal Surgery,' p. 62.

of the bowels, with discomfort and frequent spasmodic pain in the abdomen, but without the signs of an absolute obstruction. On the other hand, whenever one can say definitely that the intestine is unable to force down its contents, sedatives, it seems to me, are of no avail, because the treatment of an obstruction of the bowels by sedatives acts slowly, whereas a complete obstruction during convalescence from an abdominal section kills with great certainty in about three days after symptoms of the complication first show themselves. Treatment by purgatives may be equally unsuccessful, as in the case I have related; but urgent symptoms of obstruction after an abdominal section are often in great part caused by a paresis of the bowel, resulting from exposure and manipulation during operation. Hence, when symptoms of obstruction arise in these cases, it may be impossible to differentiate exactly to what extent paresis and to what extent a mechanical difficulty is the cause. When mechanical difficulties are the least important factor in producing symptoms of obstruction, any slight movement of a coil of intestine or of a hard mass of fæces may induce an immediate improvement. Under these circumstances sedatives, by keeping the parts quiet, may perpetuate a difficulty and so do harm, whereas the stimulation of a purge may give most satisfactory results. It seems to me that, if adverse symptoms increase under sedative treatment, the effect of a purgative should be tried, the lower bowel being first cleared by an enema. I have seen such treatment followed by the rapid disappearance of all unfavourable signs.'*

Whenever we decide to administer morphine in a case of obstruction the initial dose should not be more than $\frac{1}{6}$ grain, and this may be repeated in two hours. To give a large dose of morphia would only jeopardize the patient's chance, for a large dose would disguise the symptoms, cause a false calm, and paralyze the peristaltic movements, when we should only strive to curb them. We must always bear in mind that the sedative is only a preliminary measure, followed in the majority of cases by an operation, and that the patient's recovery will depend largely upon the presence of an efficient peristaltic action of the bowel. It is therefore unjustifiable to use any measure that will seriously impede these movements.

After having administered the morphia and allowed the

* *Lancet*, July 18, 1891.

patient an hour or so to rest and pick up, we should empty the lower bowel by a turpentine enema; and if this is without effect we should administer an alum or a quinine and whisky enema, and we may repeat this in three hours. If the necessary apparatus is at hand the electric lavage should always be tried. After waiting for a period which will vary in length with each individual case, we shall be called upon to decide whether we shall reopen the abdomen or not. In many cases we shall not have much difficulty in deciding, for the persistent vomiting, the disordered and futile peristaltic movements, and the complete constipation, can be mistaken for nothing but pseudo-ileus or peritonitis, and, fortunately, both of these conditions may be benefited by a second operation.

While we must always be adverse to reopening the abdomen hastily, it is a fatal error to put off the operation from hour to hour until no doubt of the diagnosis remains in the spectator's mind. We must remember that a patient does not die merely because the bowel is obstructed. The patient dies because she is poisoned. Death is due to intestinal septicæmia, often augmented by peritonitis. If, therefore, we hope to save our patient, we must operate early—operate, in fact, before she is so poisoned that she is beyond the pale of surgery, for we must insist that merely relieving the obstruction is not sufficient. The obstruction is not the most fatal element in the case.

Kelly says that in 1,800 abdominal section cases he has reopened the abdomen four times for ileus; two of the cases recovered and two died, and he attributes the successful results to the early diagnosis and operation.

Before proceeding to reopen the abdomen we should in all cases wash the stomach out if the patient has had stercoraceous vomiting, or if the obstruction has lasted several days. The neglect of this precaution has been the cause of death on the table of a number of cases from inhalation of the vomited matter into the trachea and lung;* while in other cases, when the obstruction has been successfully dealt with, death has

* Thus, in a case that Harrison Cripps operated on, he says: 'The patient vomited violently, bringing up a large quantity of black fæcal material. Some of this seemed to get into the trachea; he immediately became cyanosed. This increased, notwithstanding artificial respiration; in about three minutes the patient died.' Kelly records a similar fatal result when about to operate on an aged woman with obstruction, the result of a section performed many years before.

occurred from pneumonia set up by the inhaled septic vomited matter.

The anæsthetic used is a matter of little moment provided a small amount only be administered. In those cases where the patient is allowed to get into a desperate condition before anything is attempted, it will be necessary only to give her a few inhalations of chloroform while the abdominal wound is opened, and the bowel drawn up with the view of performing enterostomy. Some surgeons prefer to use cocaine.

If the patient is in a private house we should lift her on to a table in her own room. If she is in a hospital she should be removed to the theatre; but if this be too far from her room she should be placed on a trolley and wheeled to the window, care being taken to have her limbs wrapped in warm flannels, and hot-water bottles should be packed around her on all sides.

Before anything is done strychnine ($\frac{1}{20}$ grain) should be given hypodermically, and the nurse should see that the saline transfusion apparatus is ready at hand, so that the patient may have a pint of fluid injected under the breast while the operation is proceeding.

The ammonium carbonate injection alluded to in the treatment of shock should also be at hand.

As soon as the patient is under the influence of the anæsthetic the catheter should be passed, the dressings removed, and the skin about the incision washed with soap and water and then with pure peroxide of hydrogen.

Some surgeons deem that this preliminary is unnecessary if the dressings have not been disturbed since the operation. But since some days have usually elapsed since the skin was sterilized, it follows that innumerable micro-organisms will have found their way out of the pores of the skin, and therefore they should be removed. While granting that every moment is of importance, we hold that, if two minutes cannot be spared for cleansing the skin, the patient is not a fit subject for operative interference.

Before reopening the abdomen we should remember that the case is to be dealt with in one of three ways:

(*a*) The first coil of distended bowel is brought to the surface and is incised and drained.

(*b*) The site of the obstruction is sought for.

(*c*) A new incision is made and enterostomy performed.

The line of action that we should adopt will depend on the condition of the patient.

If the diagnosis has been made early, and the patient is strong, then we may open the abdomen and look for the point of obstruction; and if the patient becomes collapsed, we can rapidly close the incision after opening the first coil of distended bowel that presents.

If, however, the operator has had little experience in abdominal work, or if the patient's condition is serious, then on no account should an attempt be made to find the point of obstruction. The abdomen may be opened over the cæcum, or the original incision may be reopened, and a coil of distended bowel seized, opened, and fixed in the line of the incision.

Harrison Cripps is of opinion that temporary enterostomy should be the procedure in the majority of cases. He says: 'I doubt very much whether, even if the trouble proved to be due to an actual mechanical obstruction, the mere relief of this would in the majority of cases save the patient's life. . . . On the whole, taking the difficulty of diagnosis into consideration, together with the fact that, in any case, the distended bowel requires immediate relief, I believe that it will be better in the majority of cases at once to give relief by temporary enterostomy rather than hazard a search for the obstruction.'

This opinion is the opinion of a large number of surgeons, and we thoroughly agree with it. The only point to be decided is whether we shall reopen the original incision, or make a fresh opening over the cæcum or elsewhere.

Greig Smith was much in favour of a temporary enterostomy. He says: 'In this operation we have specially to bear in mind that the prime object in surgery is not merely to perform a scientific and technically complete operation, but to save the patient's life. An operation for intestinal obstruction is certainly not completed till the cause has been removed; but if the cause can be removed only after a prolonged and difficult operation at the expense of the life of the patient, then I maintain it is better to temporize, save the patient's life by enterostomy, and remove the constriction afterwards when the patient can bear it. In every *very* bad case I should begin by putting the patient out of immediate danger by the performance of enterostomy without general anæsthesia; as soon as she can bear it the cause of strangulation may be sought for and the operation com-

pleted.' Treves' opinion corresponds with this, and he says that 'the evidence we possess is in favour of this procedure in extreme cases.'

If we determine to reopen the abdomen in the median line, we merely remove a few sutures, and seize the first distended coil of intestine that presents, and do not trouble to hunt for the obstruction. Fortunately, the most distended coil, whether it belongs to the large or the small intestine, tends to make its way to the front, and thus it happens that the coil which presents, or which a slight examination brings to the front, is very often, as Treves has pointed out, the most dilated coil, and the one most in need of opening.

When the intestine has been drawn up it may be fixed to the parietes in one of the following ways:

(*a*) A knuckle of bowel, from 3 to 4 inches in length, is drawn up beyond the incision, and a vulcanite rod is pushed through its mesentery. The bowel is consequently prevented from returning to the peritoneal cavity. A few catgut sutures are passed through the skin, and then through the muscular coat of the bowel. A small opening is made in the surface of the bowel furthest away from the mesentery, and a catheter or a piece of drainage-tube is passed into the bowel. This procedure is particularly applicable to those cases where we wish to return the bowel in a few days, and is the one we have always used.

(*b*) A knuckle of bowel is drawn up into the incision. A curved round needle, carrying some chromic gut, is passed through the aponeurosis of the rectus, then through the muscle and parietal peritoneum, then through the serous and muscular coats of the bowel close to the mesentery; the needle is then carried through the peritoneum, muscle, and aponeurosis of the same side, and tied like a mattress stitch. A suture is placed in the opposite side in the same way. At either end the suture, after passing through the abdominal wall, pierces the bowel wall, and is brought up through the abdominal wall of the opposite side, so that when these sutures are tied the aponeurosis of the rectus is closed all round the knuckle of bowel. The bowel is now opened by a pair of sharp-pointed scissors, and the mucous membrane is turned back and united to the skin by a few sutures.

This method of enterostomy takes but a short time to perform,

and if the artificial anus has to be left for any length of time, it is a great advantage to have the anus formed in such a way that the fæces will not flow over the subcutaneous tissues. It is a common observation that the stercoraceous fluid discharged from a bowel where there is obstruction is particularly irritating, and for the first few days very septic. While the skin is sure to suffer more or less, no matter what plan is adopted, it is very necessary, as we have already remarked, to protect the subcutaneous tissues.

(*c*) The third method is the one advocated by Greig Smith. Between the second and third fingers of the assistant's left hand and the same fingers of his right hand, held back to back, a V-shaped piece of intestinal border is compressed and excluded. On the free border of this fold the incision is made large enough to admit the tubing. If the bowel is properly held no gas or fluid escapes. With fine peritoneal catch-forceps the mucous membrane on each side of the small intestine is grasped and pulled out a little way, and the tubing, stretched over a blunt probe, is pushed through the opening. The tubing is at once fixed to the margin of the incision by a safety-pin or two. If it fits accurately there will be no escape of intestinal contents by its side. The fingers of the assistant are now removed, and the gases and fluids permitted to escape. When the bowel has collapsed the loop is cleansed and returned into the abdomen, leaving outside about an inch of bowel containing the tubing. The tubing should at its inner extremity clear the parietes, but need go no further inside. The parietal sutures, already placed, are now tied, all save one, which is to be tied in a few days, when the extended loop is returned.

(*d*) The fourth method is the one recommended by Treves. The loop of gut to be opened is brought into position, and the abdominal wound is closed around it until only the dome of the loop is presenting. The gut is now secured in place by means of six or eight sutures, which involve the whole thickness of the parietal wound, the peritoneum, and the serous and muscular tissues of the bowel.

The gut is incised; Paul's glass-tube, blocked with cotton-wool, is introduced and secured by a single thread, which is buried in the groove around the base of the tube.

The objection to this method is that the thread causes sloughing of a ring of bowel, so that we always have a

fæcal fistula formed, which may persist for a considerable period.*

Harrison Cripps is in favour of making a fresh incision. He says: 'I would advise a small incision over the right iliac fossa, the incision being at right angles to an imaginary line drawn from the umbilicus to the anterior superior spine, and distant from it about 2½ inches. In this region lie the lower coils of the ileum. The incision need not be more than 1½ inches in length, the opening through the peritoneum not being more than 1 inch A portion of tightly-distended intestine will at once present itself in the wound. By means of a fine-curved needle the parietal peritoneum is stitched round the distended bowel so as to leave an area of its surface about the size of a threepenny-piece exposed, great care being taken that the needle passes no deeper than the muscular coat of the bowel. When the peritoneal cavity is thus completely shut off the exposed area is perforated by a small scalpel. A certain amount of wind and fæcal material immediately escapes with a splutter. The operator must not expect the abdomen to collapse like a pricked balloon. All that comes out at first is the gas, etc., that lies in the small segment of the particular portion of bowel opened. In the course of the next few hours, however, the distended bowel will gradually relieve itself by fits and starts. A glass or an indiarubber tube can be so arranged, with a little ingenuity, as to fit accurately into the open bowel, and being taken through the dressings will prevent the immediate soiling of the wound. Such a tube requires much attention, otherwise it will become blocked by the pressure of the mucous membrane of the opposite side of the bowel against its orifice. . . . In the last few years we have had four cases of enterotomy for vomiting and distension after abdominal section in Martha Ward. Three of the patients recovered, and one died.'

Hinder,† of Sydney, has followed this plan in three cases with

* We think, from a small experience of Paul's tubes, that they might be so constructed that the first inch of the proximal portion which fits into the gut should be of glass, and the remainder of the tube should be of celluloid, and so constructed that the latter will fit over the distal end of the glass portion. By this means we are able to introduce a catheter into the bowel, or clean the tube when it becomes blocked, with far greater facility than when we attempt to do so now, because the angle in the tube prevents efficient manipulation.

† *Australian Medical Gazette*, June 20, 1901.

success. After opening the bowel he inserts a large catheter for 2 or 3 inches, and injects 2 ounces of Epsom salts, the outer end of the catheter being nipped for twenty minutes. In one case he says, 'when the catheter was released a copious result of about a pint of thin fæces was obtained from the tube, and it continued to run into a bottle, placed by the side of the patient, for some considerable time.'

If the case is a favourable one, we may decide to search for the seat of the obstruction, and we shall then proceed in the following manner:

First notice if the bowel is adhering to the abdominal incision.

Remembering that many cases of obstruction are due to adhesion of the bowel to the pedicle, we should, in the first place, proceed to examine the pedicle. If we find that the bowel is adherent, we should endeavour to bring the seat of the obstruction well into view. To separate off an adherent bowel from a broad pedicle by mere sense of touch will probably mean a catastrophe. We must bring the parts into view, and then deliberately set to work. If the pedicle is a long one, the wisest plan is to retie it, and then divide it between the new ligature and the bowel. This will enable us to bring the liberated bowel up to the incision, and we may then dissect the adherent tissue away from it, or curette it down to a thin layer, or infold it, and suture it.

If the bowel is adherent to a sessile pedicle, and we cannot separate it without seriously damaging the bowel walls, we may either resect the bowel and join the ends together, or we may deliberately sever the bowel from the pedicle with a pair of scissors, and then bring the bowel to the incision, and form an artificial anus. In some cases that have been recorded, the bowel was so surrounded by adhesions that it could not be separated. In such cases nothing can be done but to bring a distended loop of gut up to the incision, and perform enterostomy, or occasionally to perform a lateral anastomosis.

If the bowel is adherent to the belly walls, it may be necessary to dissect off the parietal peritoneum before the bowel can be liberated.

If we find that the obstruction is not due to adhesions of the bowel to the pedicle, we may proceed as follows: In the majority of cases the obstruction will be in the small intestines; but in order to eliminate the colon at once, we may endeavour

to explore the cæcal region, and find out if the ascending colon is collapsed.

In doing this the hand must not be introduced into the abdomen; two fingers only will be sufficient. We should endeavour to inspect the cæcum, not merely feel it.*

If the ascending colon is found to be very distended, we should at once examine the left iliac fossa, and if the bowel is here collapsed we should hesitate to follow it up to the splenic flexure; because it will be a difficult procedure unless we at once enlarge the abdominal wound, for the intestines, being distended in every direction, cause the abdominal walls to become very tense. Furthermore, the manipulation necessary to reach the transverse colon—often pushed up as it is under the diaphragm—will probably inflict such an amount of damage on the distended bowels that the surgeon's heroic efforts will lead to the death of the patient later on.

But, as we have said, in the large majority of cases of ileus after pelvic surgery the small intestine is the one in which the trouble lies. How, then, should the small intestine be examined? Text-books have given very excellent rules concerning the advisability of following the collapsed bowel along to the obstruction, drawing out 5 or 6 inches only of the intestines at a time, in order to see areas of increasing congestion, and such-like directions. As a matter of fact, the young surgeon generally finds every part of the bowel that presents itself to him is distended, and he looks in vain for a collapsed part. The best plan is to inspect the coils of bowel that present themselves at the incision, and pick upon the coil that looks *most* distended or most congested, and slowly pull it through the fingers, and as gently as possible pack it away under the edge of the incision. When about a foot or two of the bowel has been dealt with in this way, we may find that the congestion is increasing, and this is our best guide to show us that we are approaching the block; if, however, the surgeon finds that the bowel looks healthier and is not so tense, then he should reverse the direction of his search. During all the manipulation the surgeon must bear in mind that any rough manipulation will be sure to inflict innumerable rents in the peritoneal coat of the distended coils, and that these rents may lead to a fatal peritonitis even if the obstruction be successfully dealt with. If after ten minutes' search the obstruction

* 'Il faut voir le cæcum et ne pas se borner à le sentir' (Lejars).

is not found, then we should at once proceed to open the bowel, or to allow the distended coils to protrude. We should be guided entirely by the patient's condition as to which of these steps we shall follow; probably in the great majority of cases enterostomy is the safer plan.

If we determine to allow the bowels to protrude we should spread two towels that have been wrung out of hot saline solution on either side of the parietal incision, and as the bowels protrude they are enveloped in these towels. Hot saline solution (105° F.) from an irrigator suspended over the table should be allowed to flow continuously over the towels, or the outer towels should be constantly changed and fresh ones from hot saline solution substituted, so as to prevent the bowels becoming chilled, and to minimize shock.

When the obstruction is discovered it is dealt with as the condition demands.

The next step is to return the bowels; this may be attempted in one of the following ways. An assistant hooks the index-finger of each hand under either end of the incision and pulls the abdominal walls up, while the surgeon pushes the intestines back, pressing on the coils with large hot sponges. Instead of the fingers two blunt hooks may be used for holding up the abdominal walls, and, in addition, we may insert a stout silk thread through each wall of the incision, and by pulling on these we can more easily keep the sides of the incision apart. If we fail to return the intestines, then we must either enlarge the opening,* or proceed at once to open the distended bowel by isolating a loop of the intestine, and making an incision $\frac{1}{2}$ inch in length. Through the opening the bowels may be emptied, the contents being milked out of them. A few sutures are placed to close the opening, and a pair of forceps are left attached to the sutures to mark the seat of the incision. The bowels, no longer distended, may be returned with ease, care being taken to keep that portion of bowel that has been opened under observation, so that it may be brought to the edge of the incision, and there fixed if thought necessary.

In all cases where considerable delay has occurred before the operation, and the intestines are much distended, it is not sufficient to merely relieve the obstruction, it is absolutely

* Kummel and Lejars both recommend an incision from the xiphoid cartilage to the pubes.

imperative that the bowels should be emptied. If the patient has been eviscerated, this may be done effectively and rapidly; but if the obstruction has not been found, or, if found, the bowels remain distended, then we adopt the plan long advocated by Greig Smith and others: 'The bowel is opened transversely to its axis, and then the bowel, properly protected, is pulled a few inches away from the wound and held over a vessel with both hands, while an assistant gently kneads the sides of the abdomen to force the fluids along the bowel and up to the opening. . . . The proceeding of evacuation and drainage of intestinal fluids occupies some time, and as prolonged anæsthesia is full of danger, I have recommended that it be carried out after anæsthesia has been stopped. At least half an hour—probably an hour, or even longer—will be occupied in completely emptying the intestines. The surgeon may sit down on a chair by the bedside or operation-table watching and encouraging the process. The piece of bowel drawn out of the parietal opening is covered with several thicknesses of sponge-cloths, only the part from which evacuation is taking place being exposed. At varying intervals fluids and gases escape in great quantities, and may be conducted into a suitably-placed vessel by means of a long piece of rubber tubing. When the abdomen is flat the opening in the bowel is closed and the bowel is cleansed and returned, and the parietal sutures already placed are tied. If it is decided to keep the intestinal opening pervious, the bowel is fixed in the wound.'

Should we find the bowel in a state of gangrene, we should draw the loop of intestine out of the abdomen and secure the healthy gut on either side of the gangrenous area to the margin of the wound, which should then be closed around the two ends of it; afterwards the bowel is incised, and the contents allowed to escape. Treves says that in cases in which gangrene exists, experience is against any attempt to unite the divided ends of the bowel immediately after the necrosed portion has been excised.

Macnaughton-Jones says that in a recent visit to Berlin he saw Martin operate on a case of obstruction after cœliotomy. The bowel was found to be gangrenous, and the diseased portion was excised and the ends joined together. The patient, however, died.

The following case recorded by Maylard* shows well the

* *Lancet*, October 12, 1901.

difficulties that may be encountered in these operations to relieve an obstructed bowel:

The patient, aged seventeen years, was first operated on for acute intestinal obstruction. On opening the peritoneal cavity a stream of fœtid pus escaped. The left appendages were found in a pocket of offensive pus, but the patient's condition was so serious that the appendages were not removed. The various septic areas were plugged with iodoform gauze.

For eight days progress continued uninterruptedly, except that a bad bedsore formed over the sacrum.

'Nine days after the operation I found her on my morning visit suffering from evident symptoms of acute intestinal obstruction, and concluded the cause to be some kinking or bending down of the bowel, the result of the adhesions about the seat of the original operation.

'The patient was again removed to the operation theatre, and an incision was made through the parietes in the median line below the umbilicus. As my object was not only to liberate the supposed involved loops of intestine, but to remove the left appendages, I preferred to do this through a fresh incision in the median line rather than to reopen the existing septic channel. My first encounter was with another localized fœtid abscess, which was encircled and retained by loops of matted intestine; this, as in the previous one, was swabbed out. At the same time, every precaution was taken to prevent any septic infection of the upper part of the abdominal cavity. The matted intestines were again disengaged and withdrawn from the abdomen, so as to insure of no involved loop escaping observation. Search was then made for the left ovary and tube, but these were found so inseparably matted to the anterior wall of the pelvis, and free from any neighbouring septic material, that it was decided not to prolong the operation by any attempt at their removal. When it was supposed that the operation was completed so far as the intra-abdominal part was concerned, it was accidentally discovered that a distended and congested loop of small intestine presented at the upper part of the parietal wound. The parietal incision was extended upwards sufficiently to expose the bowel above, when it was found that a tense fibrous band extended transversely across the gut, completely occluding it. The band was divided, but the bowel failed to empty itself onwards; hence an incision was made into it, and its contents were allowed to

escape, or rather were made to escape by passing the distended gut between the fingers. Another difficulty now presented itself. It was found impossible to empty, even by this manipulative process, a long coil of small intestine lying higher in the abdomen. On searching for the reason, it was soon found that this loop of intestine had formed a complete twist upon the mesentery. When untwisted the remaining contents of the distended gut were easily squeezed out through the enterotomy wound.' The patient recovered.

CHAPTER XL

THE URINE — THE CATHETER — IRRITABILITY OF THE BLADDER AND CYSTITIS

The Urine.

After a section the amount of urine passed by the patient is markedly less than the normal quantity, which in gynæcological cases may be taken as 35 ounces in twenty-four hours.

If the case has been an uncomplicated one, the patient will secrete about 4 ounces in the first five hours after the operation, and in the first twenty-four hours the average quantity is about 17 ounces. During the second and third days the quantity increases to 20 ounces, and on the fourth day it is usually 25 ounces. From this onwards, if all goes well, the urine increases day by day; but it is not until the second week is well advanced that the urine passed in a day amounts to over 30 ounces.

Should the case be complicated by shock or hæmorrhage, the amount of urine passed during the first days may be very small, in many cases not more than 10 ounces per diem.

Since it has become the custom to administer large quantities of saline purgatives soon after the operation is completed, these, by producing copious watery motions, serve to diminish the quantity of urine passed. On the other hand, the administration of normal saline solution by the bowel and subcutaneously, undoubtedly causes an increase in the amount of urine secreted during the first days.

It is a rare event for antiseptics to be the cause of diminished excretion of the urine in the present day, but formerly, when carbolic and iodoform were freely employed, suppression of urine was not a very uncommon accident.

The employment of ether as an anæsthetic has a distinct influence on the amount of urine passed; it diminishes the

quantity excreted, and in the presence of nephritis it undoubtedly may be the cause of actual suppression.

When one ureter is tied or severed, the quantity of urine passed is diminished; when both are tied there is, of course, anuria.

It should, however, be noted that though neither of the ureters may be ligatured, mere kinking may lead to anuria.

The Catheter.

It is not unusual—in fact, it is almost the rule—for a patient to be unable to pass her urine for some days after a section. Probably her position in bed—lying on her back, often with the foot of the bed raised—accounts for this. There will, however, be no necessity to pass the catheter for the first twelve hours, as the quantity of urine in the bladder will give rise to no inconvenience, and we should always encourage the patient to pass her water rather than resort to the catheter. If, however, the patient has not passed water eighteen hours after the operation, the nurse may draw it off.

Many nurses pride themselves on being able to pass a catheter without uncovering the patient. This, however, is not a wise practice to follow; it is a much better plan for the nurse to expose the parts, swab the meatus with some carbolic solution, and then introduce the catheter directly into the urethra without fumbling and paining the patient and introducing any vaginal discharge into the bladder, as is frequently done when the catheter is passed under cover of the bedclothes.

The catheter that we prefer is one made of glass, and after it is used water should be run through it at the tap; then it should be boiled in water with some carbonate of soda, and kept in water until required, when it is dipped in a little sterile olive oil. The nurse should not smear the catheter with vaseline taken from a gallipot which has been used for smearing the enema pipe, because the vaseline in such pots is seldom sterile.

After operations for fibroid tumours, when the bladder has been stripped off the anterior face of the uterus, it will sometimes be found that the patient has a desire to pass water very frequently, and it may even run away in the bed. This constant desire to pass water is very distressing; it is best treated by introducing a morphine suppository into the rectum.

Patients will also desire to pass their water frequently if the

bladder has become overfilled. Every nurse should be on her guard when a patient is constantly passing small quantities of urine, and she should always draw the surgeon's attention to the fact. In one of Kelly's cases where an overdistension of the bladder followed ovariotomy, portions of the mucosa were cast off, and the patient had a high fever and became insane.

If the bladder has been injured during the course of the operation, and sutures have been introduced, or if the outer coats have been torn away in separating adhesions, it would be unwise to allow the urine to accumulate in the bladder, lest the distension might lead to rupture. Either the water must be drawn off every four hours, or a rubber or self-retaining female catheter must be left in the bladder, and the urine conducted by a piece of rubber tubing to a receptacle at the side of the bed.

When the water has been passed or drawn off, the nurse should measure it, and should make a note of the quantity, and the time when the urine was passed, in the case-book.

Some urine should be saved and tested once every twenty-four hours for the first three or four days when the patient is progressing favourably, and it should be tested every day while any complication is present.

If blood* or albumin be discovered in the urine on the first day, it may be due to injury to the bladder or ureter, or it may be due to acute nephritis.

If blood be discovered on the second or third day the surgeon must always inquire whether the urine has been drawn off by the catheter, or whether passed naturally; in the latter case, the urine should now be drawn off by the catheter, so as to eliminate its accidental contamination by the blood due to the metrostaxis, while the albumin found may be accounted for by the presence of leucorrhœa.

Irritability of the Bladder and Cystitis.

During the course of the second week after an operation, patients are often troubled with irritability of the bladder. This is due in some cases to the urine becoming concentrated and loaded with phosphatic salts and urates, and when tested it is found to be very acid. This urine causes hyperæmia of the

* After operating on a woman for a mesenteric cyst situated over the left kidney, the patient passed large quantities of blood in her urine for two weeks after the operation.

trigonum of the bladder. In other cases the irritability is due to cystitis, produced by the frequent use of the catheter, which causes traumatism of the bladder wall. In some cases the cystitis is caused by the employment of an unclean instrument, or by the accidental introduction of the vaginal discharge into the bladder.

After performing hysteropexy on women who have long suffered from prolapses, we find that cystitis not unfrequently occurs, the reason evidently being that the bladder in these cases, having been previously dragged down into the vagina by the displaced uterus, is frequently in a state of chronic congestion due to the irritation of the residual urine. After the operation, if a catheter is passed in these cases it may cause a slight traumatism, and the scanty, highly irritating urine excreted after an operation may then be sufficient to create these favourable conditions for pathogenic organisms to increase the cystitis.

In other cases the irritability is a symptom of pericystitis, secondary to pelvic peritonitis, or pelvic exudates in the neighbourhood of the bladder. In other cases an interstitial and an endocystitis is produced by a pelvic focus of infection—probably in some cases from the septic pedicle—reaching the muscular and mucous layers of the bladder by means of the lymph channels.

Probably some cases of irritable bladder are to be accounted for by the trophic change going on in the bladder, and due to the interference with the blood-supply of the viscus during the operation.

Pathologically considered, the cystitis usually encountered is a catarrhal one, but rarely we may encounter a suppurative or an ulcerative cystitis.

The urine in many instances is acid, as the micro-organism found is frequently the *Bacillus coli communis;* and since this bacillus does not decompose urea, the urine remains acid until the ordinary pus microbe, or the *Micrococcus ureæ*, is introduced, when the urine becomes alkaline.

Treatment.—The observations of Russell and of Clark show that the frequency of vesical irritability in post-operative cases is due to the retention of small qnantities of highly concentrated urine in the bladder, while the persistent renal torpidity is due to the irritant or toxic effects of the greatly concentrated urine; and by supplying the body with a quantity of salt solution this

partial suppression is to a great extent prevented, and the kidney at once resumes its normal function as soon as the patient begins to take fluids.

In the light of these observations it will be advisable in all cases where there is any suspicion that the kidneys are not working to introduce a litre of saline into the bowel at the conclusion of the operation, and we are accustomed to add to this injection a few drachms of acetate of potash, since this is one of the most efficient and mildest of diuretics.

If the amount of urine passed is small we always give the infusion of digitalis with acetate of potash, and this usually has the desired effect. If, however, the digitalis upsets the stomach it may be given by the bowel, and we may give by the mouth a few drachms of spiritus ætheris nitrosi in large draughts of barley-water.

When the bladder becomes irritable during the second week, we resort to bicarbonate of soda, or to acetate of potash and digitalis. At other times we find that saccharin acts well, while salol in doses of 15 grains three times a day is also useful.

If cystitis develops, the bladder should be immediately washed out with a very weak solution of permanganate of potash, or 1 ounce of boro-glyceride to 1 pint of water.

When the cystitis develops weeks or months after the operation and becomes persistent, we should always remember that this may be due to the presence of silk ligatures which have found their way into the bladder.

CHAPTER XLI

COMPLICATIONS ARISING IN CONNECTION WITH THE KIDNEY, URETER, AND BLADDER

Injuries to the Kidney.

We have already, in considering the preparation of the patient for her operation, dwelt at length on the important rôle that the kidney plays in influencing the results of operations; and we have pointed out that in operating on a patient affected with Bright's disease we are operating on an extremely bad subject, for the renal lesion may be the direct cause of death, or it may be the contributing cause by decreasing the patient's resisting powers to infection.

If the patient has healthy kidneys previous to the operation, then we may say that the kidneys will not be affected by the operation. The only difficulty is to determine whether the kidneys or ureters are free from disease, for the mere absence of albumin, pus, or blood gives us no guarantee that the kidneys or ureters are free from disease.*

While a properly conducted operation in itself will not influence a healthy kidney, it should be borne in mind that the careless exposure of the patient and the chilling of her body by wet towels during a prolonged operation may cause the kidney to become congested, and this is more likely to happen if ether is administered as the anæsthetic. In the past the absorption of carbolic acid, and in the present day poisoning by iodoform, have led to nephritis and fatal results; and we have known two deaths to occur after using peroxide of hydrogen with very small quantities of iodoform.

* We recently removed a large ureteral calculus, situated 5 inches below the kidney; but the urine, although continually examined before the operation, showed nothing abnormal.

The following cases will illustrate the occurrence of nephritis, suppression of urine, and uræmia after sections:

Thornton* performed a section on a child aged seven years for hydronephrosis of the left kidney.

At 9 a.m., half an hour before the operation, the patient's temperature was 99·4° F., and twenty minutes after she was placed in bed it was 97·8° F., pulse 116, respiration 28. At 11.45 a.m. 3 ounces of clear, pale urine were drawn off by catheter. It was exactly like that examined the day before the operation, and deposited white urates. The patient frequently vomited. At 3.30 p.m. the pulse had risen to 136, and at 9.30 p.m. to 150; respiration 32, temperature 101·6° F. At 3.30 p.m. about 1 ounce of urine was drawn, dusky in colour, and containing some black clots. From this time till 3 a.m. on the following morning, about 1 ounce was passed without the aid of the catheter every hour and a half, each specimen being bright red, as if almost pure blood. Eighteen hours after the operation some urine was passed quite free from blood and containing urates as before the operation, and from this time onwards a fair quantity of healthy urine quite free from albumin was passed.

Thornton attributed the extreme congestion of the kidney to carbolic acid, and remarks that 'we know that there is often considerable congestion of the kidneys after ovariotomy, and that this has been decidedly increased in severity since the introduction of antiseptics into abdominal surgery.'

Such cases are not likely to occur at the present day from carbolic acid, but they certainly do occur occasionally from iodoform-poisoning, as we have shown in the paragraph devoted to the latter subject.

Cullingworth† operated on a case of chronic salpingitis. The patient was much collapsed after the operation. Next day the urine was found to contain a trace of albumin. The quantity of albumin increased, and the urine became scanty and smoky. Death took place on the ninth day. The temperature, except on the day following the operation, was uniformly under 100° F.

At the autopsy the kidneys were intensely hyperæmic, and generally showed evidence of acute nephritis, and this was con-

* *Lancet*, June 5, 1880.

† *Transactions of the London Obstetrical Society*, 1893.

sidered the true cause of death, for the parts concerned in the operation appeared to be as healthy as could be desired.

Rufus Hall* considers that patients with fatty hearts are liable to have suppression of urine after sections. In one of his cases, in which this condition was diagnosed, he performed hysterectomy. In the first nineteen hours after the operation she secreted 24 ounces of urine, heavily loaded with albumin. During the next seventy-four hours there was almost complete suppression. Coma became marked, but it was promptly relieved by steam baths and catharsis. At the end of seventy-four hours she was catheterized, and $1\frac{1}{2}$ ounces of urine obtained. From this onwards she improved.

Suppression of urine is not uncommon in elderly women with atheromatous arteries, and the symptoms in some of these cases may give little cause for alarm, while in other cases uræmic symptoms are prominent.

Malcolm † operated on a woman aged sixty-four years. Seven hours after the operation she passed 4 ounces of urine, and after twelve hours she passed $2\frac{1}{2}$ ounces more. Six hours later 1 ounce was passed. All the urine was free from albumin, and had a specific gravity of 1026. Twenty-eight hours after the operation the secretion from the kidneys was very slight, and the patient was drowsy, and on the catheter being passed 1 ounce was drawn off. Eight hours later the catheter was passed, but there was no urine in the bladder; the secretion had become entirely suppressed. Forty-eight hours after the operation 1 ounce was voided, and this contained a trace of albumin. The amount then increased, and on the third day 77 ounces were excreted.

Malcolm remarks: 'The patient's arteries were all very tortuous and atheromatous, and the blood-tension became so low that for eight hours there was no secretion of urine. As is usual in such cases, there was a compensating excessive secretion later on. It is, of course, open to question whether the opium and stimulants which were administered may not have acted adversely on the secretory action of the kidney.'

Doran‡ long ago asserted that the diseased condition of the kidney was a frequent cause of death after ovariotomy, inasmuch

* *American Journal of Obstetrics*, vol. ii., 1898, p. 679.

† *British Medical Journal*, December 16, 1899.

‡ 'Tumours of the Ovary,' London, 1884. p. 162.

as the pressure of the tumour on the ureter as it crosses the brim of the pelvis tends to a diffuse interstitial nephritis.

Knox* has recently investigated the effect of 'compression of the ureters by myoma uteri,' and some of his conclusions are:

1. That some compression of the ureters is produced by a large proportion of all myomatous uteri.

2. The resulting hydro-ureter and hydronephrosis may continue for years, and give rise to no discomfort to the patient.

3. The presence of a dilatation of the ureter and renal pelvis, however slight, lowers the resistance of these organs to toxic and infectious agents, and hence inflammatory conditions of the ureter and kidneys not infrequently follow ureteral compression.

Usually when the interference with the outflow of urine is not extreme and is of short duration, a slight parenchymatous nephritis (cloudy swelling) is found on section. This gives way in the later stages to the chronic interstitial nephritis, unless the obstruction becomes complete, when the hydronephrosis involves the whole organ.

Knox says that in diagnosing these cases the examination of the urine has proved an unreliable aid. For cases of moderate pressure the urine has frequently been reported negative.

It will readily be seen that, if we are called upon to perform hysterectomy in such cases, though the operation may be successfully carried out, the patient may succumb from the condition of her kidneys.

The following case illustrates this:

A patient, aged forty, consulted Rochet for symptoms indicating pressure upon the bladder. The examination of the urine showed nothing. On operating, a mass was found firmly wedged in the pelvis and adherent to both rectum and bladder. The growth was removed. The day after the operation the patient became restless, had a constant desire to urinate, but the bladder remained empty. Dyspnœa and Cheyne-Stokes breathing ensued, with rise of temperature and pulse-rate, ending in death on the evening of the second day.

At the autopsy the organs, with the exception of the kidneys, were found to be normal. The left kidney was enlarged. There was marked dilatation of the calices and pelvis, but no pus. The renal substance was much atrophied. The left ureter was

* *American Journal of Obstetrics*, 1900, vol. ii., p. 348.

markedly dilated. The right kidney was absent, and replaced by a small nodule the size of an almond in a fatty capsule. The corresponding ureter was filiform, but patulous throughout its entire length. The anuria was probably due to the small amount of renal substance remaining being thrown out of action by the shock of the operation.

Rufus Hall operated on a patient aged sixty-three, and performed abdominal hysterectomy for cancer of the uterus. Her arteries were atheromatous. Before the operation there was a diminished quantity of urine, but no albumin nor casts. Chloroform was administered. During the first twelve hours she secreted 5 ounces of urine, heavily loaded with albumin. The urine gradually decreased in quantity, until at the end of fifty hours there was scarcely any secreted. She remained in a condition bordering on coma for two days. She then commenced to secrete from 6 to 9 ounces of urine in twenty-four hours. This improvement lasted for more than a week; then there was sudden suppression, and she was profoundly comatose for ten or twelve hours. At the end of the third week following the operation she had suppression for the third time. It lasted two days. She recovered, and the albumin entirely disappeared.

Harrison Cripps records a case of a woman, aged fifty-two years, who was operated on for an ovarian cyst. Nothing abnormal was discovered in her urine, and there had been no previous history of kidney trouble. She did well until the fifteenth day after the operation, when she was suddenly seized with severe pains in the left side and severe vomiting. She complained of pain all down the right side. The patient passed only a very small quantity of urine the next day. During the next two days she practically passed none, but there was blood found in the bladder on using the catheter. She died on the fourth day after the attack, the suppression of urine having lasted till death.

The autopsy showed that all the organs were healthy except the kidneys. The right kidney weighed 6 ounces and contained six small calculi, but no pus; pelvis dilated. The left weighed 9 ounces and contained 2 ounces of pus, the ureter being completely blocked by a calculus.

Symptoms.—The symptoms that we may expect will depend on the degree of mischief in the kidney.

In all cases after cœliotomy we have a marked diminution in

the quantity of urine excreted, and it is only when the quantity after the second day diminishes or stops altogether that we may suddenly realize that the kidney is in a state of hyperæmia, or that the patient is attacked with nephritis.

The mere occurrence of albumin after an operation in urine which was previously free from albumin and casts* need not occasion any alarm, for it has been shown by many observers, such as Thompson, Kemp, and G. B. Wood, that albuminuria very frequently follows the administration of an anæsthetic, and more particularly ether. Comparative research has shown that after ether narcosis the kidney appears congested, and in some cases there is cloudy swelling of the renal epithelium.

It is only in cases where we are well aware of the presence of renal disease that the sudden diminution or total suppression of the secretion will cause us alarm. In these cases when sudden suppression occurs we must suppose 'that all the essentials for the catastrophe have been present but latent, and that the fatal climax is suddenly reached by some extra severe nerve stimulation, which causes reflex flooding of the kidney. Probably the renal vessels have often been distended before, but have recovered themselves, though their nervous control has become each time more and more unstable. The final blow paralyzes the local vaso-motor function reflexly; the vessels are overdistended, and cannot empty themselves; epithelium necrosis ensues, filtration ceases, the process of secretion proper—*i.e.*, by which the urea and the principal urinary solids are eliminated—is checked, and total suppression is the result' (Fenwick).

In the mildest cases where we have merely a passing hyperæmia, unless a special examination of the urine be made, nothing will be noticed in the patient's appearance to attract attention.

In mild cases of nephritis, the patient, instead of ceasing to vomit at the end of twenty-four hours, will continue vomiting for some days, and she may be troubled with hiccough. The pulse will keep up to 120, and the temperature will be 101° to 102° F.; the urine will be high coloured, and the specific gravity 1020. Albumin is present, and also hyaline casts.

In the severe cases we have all the symptoms of acute nephritis,

* Robb, in a series of 114 consecutive successful sections, found albumin in the urine in twenty cases, and in eighteen of these granular and hyaline casts were present. In nine of these cases the albumin and hyaline casts were only demonstrated after the administration of the anæsthetic.

followed in some cases by uræmia, with Cheyne-Stokes breathing, delirium, drowsiness and coma, and death from the renal lesion; or the renal lesion may help to bring about a fatal result by lowering the power of resistance to infection.

Prognosis.—The prognosis is always grave when there is known renal disease present. Kelly says: 'Although acute congestion of the kidneys or acute nephritis are often assigned as the cause of death after surgical operations, I am unable to find a single record of such a case either in my clinical histories or autopsy records.'

This has certainly not been the experience of others, and there is abundant evidence to show that many cases have died after cœliotomy from acute nephritis. Rufus Hall found that in 110 sections in which 'ether was the anæsthetic, in thirty-three cases (30 per cent.) there was a trace of albumin in the urine for the first twenty-four hours after the operation. In ten cases (9 per cent.) there was partial or complete suppression, varying from one to four days. Two of these patients died in coma.'

In 500 sections in which chloroform was used there was a trace of albumin in eighty-five cases after the operation. In ten cases there was suppression varying from one day to four weeks. Four of the cases were known to have chronic nephritis, and died of uræmia.

Lloyd Roberts recently recorded the following case of fatal uræmia after ovariotomy:

'A patient, aged fifty-eight, a multipara, was found to have a large ovarian tumour extending to about 3 inches above the umbilicus. There was a considerable cloud of albumin in the urine. The patient was left under treatment by diet and medicine until the urine contained a mere trace of albumin. Abdominal section was performed, and an ordinary multilocular ovarian tumour on the left side removed. After operation the quantity of urine decreased, and the albumin increased again. The patient became restless and sleepless, and vomited frequently. Death from uræmic coma took place on the tenth day, only 8 ounces of urine loaded with albumin having been passed during the last forty-eight hours of life.'

There were no signs of septicæmia or peritonitis. Post-mortem, there was double nephritis, the other organs being healthy.

Doran remarks on his own researches on diseased kidneys found post-mortem after cœliotomy: 'It must be remembered that the diseased kidneys I have described here at length are, of necessity, from fatal cases, and I strongly believe, as I have asserted already in the course of discussion at societies on ovariotomy mortality, that their diseased condition was the chief cause of death.'

Prophylactic Treatment.—We have pointed out in another portion of this work that, with the exception of cases of 'imperative surgery,' the urine should be carefully examined, not once, but two or three times before any operation is decided on. Neglect of this rule means an inevitable disaster sooner or later to some of our patients should a cœliotomy be performed.

If the examination of the urine shows that there is a considerable quantity of albumin and casts, then the operation should be delayed until there is a very great improvement in the condition of the kidneys.

We have on several occasions been able to demonstrate the great benefit that patients suffering from nephritis may derive from a prolonged rest in bed, while the diet is strictly attended to. One case in particular we may record.

The patient was a woman, aged thirty-five, who came to the Lewisham Hospital with an immense cystic tumour (hydatid) filling the abdomen. Her legs were riddled with varicose ulcers, and distended to twice their natural size with dropsy. She was unable to walk or take the slightest exertion. Her heart was displaced, and she was unable to lie down in bed. Her urine was almost solid with albumin. She was kept in bed for two months, being fed on milk and farinaceous food, and she was given digitalis and acetate of potash every four hours. The albumin diminished greatly, but there was a marked cloud at the time she was operated on. She made an excellent recovery, and the albumin gradually disappeared from the urine during the three months that she remained in bed after the operation.

In several other cases we have adopted the plan of continued rest previous to the operation, giving all the time digitalis and potash, and the patients have recovered without any uræmic symptoms.

In all cases where the kidneys are considered to be more or less damaged, we request the anæsthetist to employ chloroform

in place of ether. Buxton says that in these cases it is well to substitute A.C.E. mixture for ether.

During the operation itself the greatest care should be taken to keep the patient well clothed and surrounded by hot-water bags, while we should be careful not to saturate the coverings while flushing the abdomen.

At the conclusion of the operation a quart of normal saline solution may be left in the peritoneal cavity; or we may give a rectal injection or submammary transfusion, adding 1 drachm of digitalis and 2 drachms of acetate of potash to the saline fluid, so that the urine may be increased, and being less concentrated will be less irritating and toxic, and the kidney is more likely to resume its normal functions.

We must be careful not to give alcohol or opiates, and the patient should be fed on farinaceous foods and milk, beef-tea and meat juices being avoided.

Therapeutic Treatment.—Should symptoms set in which point to nephritis, we should at once proceed to assist the kidney by administering saline purgatives and diaphoretics, and we should administer large submammary injections, to which we may add acetate of potash. The binder and dressing may be taken off and the wound covered with a thick coat of collodion, and the patient placed in a hot pack.

If we have any difficulty in getting the patient to perspire, we may raise the blanket of the bed on a pole so as to make a tent, under which we should introduce the nozzle of a bronchitis kettle so as to steam the patient.

The Keiths report a case of pyosalpinx operated on by Emmet. After the second day the pulse rose to 140, and the temperature to 103° F. There was anuria. The patient sank rapidly. The loins and back of the chest were dry cupped in twelve places at the same time, the patient being unconscious. Before the tumblers had been taken off, at the end of fifteen minutes she was conscious and sweated profusely all over the body, and by next morning the kidneys had recovered their functions and the patient was out of danger.

The following fatal case of uræmia occurred in our own practice:

The patient, aged twenty-six, had suffered much for two years before we operated on her. She had a very rapid pulse after we had removed two small ovarian tumours filled with pus, and the

appendix, which was adhering to the right ovary. Previous to performing the section we had curetted the uterus, and repaired a very extensive laceration of the cervix. During the first night, although only 20 minims of liquor strychninæ had been injected, the patient had distinct strychnine convulsions. There was a loss of a few ounces of blood from the vagina, and—as the autopsy showed—there was oozing to the extent of a few ounces from adhesions in Douglas's pouch. This small loss of blood helped to send the pulse-rate up until the radial pulse could not be felt, and the patient became very blanched. After some days we determined to administer the tincture of digitalis in drachm doses, as the patient was well able to retain any fluid given by the mouth. The first drachm was given at midnight, the pulse being then 150, and the second dose was given in three hours' time. In the morning the pulse had fallen to 110, and it continued to fall until next day, when it became a pulse of high tension. As the patient's urine had large quantities of albumin, and she was only passing 4 ounces every eight hours, we determined to dry cup her, and then to keep linseed-meal poultices over the kidney, while we administered acetate of potash and nitro-glycerine. The administration of the latter drug soon made a distinct change in the character of the pulse, and the urine began to increase almost immediately. She, however, continued to be drowsy, and although there was no vomiting, and the pulse and temperature were favourable, she gradually developed well-marked uræmic symptoms, and died on the ninth day. The autopsy showed that there was no sign of peritonitis. There had been a little oozing in the pouch of Douglas. The kidneys showed well-marked evidence of nephritis.

In another case which developed peritonitis, after removing the appendages and the appendix, the patient had complete anuria for thirty-six hours before death. The pulse and temperature at death were normal. She died on the fifth day, enterostomy having been performed on the third day to relieve the tympanites.

Injuries to the Ureters.

1. **Ligature of Both Ureters.**—Injury to the ureters during a section is by no means a rare accident. Morris says that to-day 'there are few surgeons who have done many major operations on the pelvic and abdominal organs who have not

had the misfortune once or oftener to divide, or even to excise, a portion of the ureter, either through necessity or by accident.' This accident has happened frequently in the past, and occurs during the present day in the practice of even the most skilled. Sir Spencer Wells stated in 1881 that out of ninety-four published abdominal hysterectomies, one ureter had been divided in six cases, while both ureters had been divided in two other cases.

Purcell in 1898 read a paper before the British Gynæcological Society on 'Risks to the Ureters,' and during the discussion Macnaughton-Jones said that he had inquired from Martin of Berlin, Landau, Doyen of Paris, and Kufferath of Brussels, as to the occurrence of this complication in their practice.

Martin replied that it had occurred to his knowledge in vaginal operations in two cases, and in abdominal cases three times, and that he had lost two of these latter cases, one through uræmia and the other by septicæmia, after having reopened the abdomen and freed the ureter.

Doyen said that he had had only a single case of ureteral fistula, and this occurred after a vaginal hysterectomy.

Landau said that in 700 cases of abdominal sections he had not had this accident, but that in 124 vaginal hysterectomies for cancer he had had it once, and in this case he did nephrectomy and saved the patient. In 99 cases of vaginal hysterectomy for myoma he had had the accident in 5 cases, all of which recovered, though he had had to do nephrectomy in 3 of these cases. In 270 cases of removal of the appendages by the vagina, he had had 2 cases, both cured by nephrectomy.

Kufferath said that he had injured the ureter in a hysterectomy performed according to Kraske's method; the patient died fifteen days after the operation. He had also severed the ureter in a case of laparotomy for myoma, but fixed it into the abdominal wound, and the patient recovered. Later on he successfully performed nephrectomy.

Howard Kelly says that in his experience he knows that he has ligated the ureter three times, and the accident has occurred in the hands of his assistants twice.

One or both ureters may be severed, or ligatured, or may become kinked, or a stitch may be passed through the walls of the duct unknowingly. After the patient is returned to bed nothing unusual may be noted for the first twenty-four hours, even if both ureters have become occluded. Such an accident is

not necessarily a rapidly fatal one. Sir William Roberts has described under 'latent uræmia' instances where there was complete suppression of urine from the simultaneous obstruction of both ureters, and some of these patients lived for fourteen days, the symptoms being remarkable for the slight intensity.

Purcell, in the paper alluded to above, remarks that anuria, which follows ligature of the ureters, once established may last many days without causing any symptoms of uræmia. Even when the suppression is complete, some eight or ten days may elapse before the symptoms of uræmia appear, and sometimes death occurs without any of the characteristic signs of uræmia appearing. If both the ureters have been ligatured there will of necessity be anuria, and we shall have to decide whether we are dealing with a case of suppression due to acute nephritis or to ligature of both ureters.

In deciding this point we shall have the condition of the patient's urine previous to operation to help us. If the patient has had symptoms of nephritis before the operation, then it would be unusual to have such an exacerbation of the nephritis as to cause complete anuria immediately; exceptionally, this has occurred after slight operations on the urinary organs, and death has taken place within twenty-four hours. We would rather expect that some water would be secreted loaded with albumin and casts, and this might be followed by anuria, while with ligature of both ureters the bladder will be almost empty, or contain but a very little blood-stained urine.

Symptoms.—The anuria is the outstanding fact. Pain will be complained of in the region of both kidneys, but this may cease as soon as the pressure of the pent-up urine in the renal cavity and the pressure of the blood within the renal vessels are equalized.

If the case is uncomplicated by septicæmia, the pulse will be slow and full, and later on will become irregular. The temperature will fall to 97° F., profuse perspirations may occur, but the skin will be dry as the end approaches. Vomiting is a conspicuous symptom, and constipation is obstinate. There may be contracted pupils, and even muscular tremors.

As salt injections are sure to be tried during the treatment, it will be found that very soon an abundant transudation of fluid takes place into the peritoneal cavity, and this will be discovered when the abdomen is reopened if an operation is attempted; it

must not be confounded with an escape of urine into the serous cavity.

Treatment.—If after a few days the anuria still persists after saline subcutaneous injections have been tried, purgatives administered, and saline fluids with acetate of potash injected into the bowel; and if the patient's temperature is subnormal and the vomiting is persistent, we must then proceed as follows:

1. Persistent treatment by saline injections, administration of acetate of potash and pilocarpine, dry cupping and hot packs.
2. Give an anæsthetic, and endeavour to catheterize one of the ureters.
3. Reopen the abdomen and examine the ureters.

To say which course should be pursued in any one case would be useless; we must be guided by the probable condition of the patient's kidneys *before* the operation and the immediate symptoms present. It would be folly to proceed to operate for anuria unless this has persisted for fifty hours, while, on the other hand, to wait day after day because the patient shows no signs of uræmia would be a grave mistake; for if the patient's kidneys are healthy before the operation, she may not develop uræmic symptoms even with both ureters ligatured.

Passing a catheter into the ureters, while it is advocated by Boldt, does not at present promise a wide field of usefulness; for unless the operator has had much practice with the ureteral catheter, he will most likely fail in his object. Even Kelly says that 'it is not practicable, on account of the condition of the patient, to catheterize or to sound the ureters after operation.'

Once having made up our minds that the anuria is not due to nephritis, loss of blood, or shock, the only course that is left to us is to reopen the abdomen and look for the points of obstruction.

This has been successfully done in more than one instance. Purcell performed hysterectomy on a woman aged fifty-one years. She progressed satisfactorily for thirty hours, the pulse being 99 and the temperature 98·2° F., but she had all the time complete suppression of urine. Fifty hours after the operation the temperature was 97·8° F., pulse 90, tongue clean, anuria, vomited repeatedly during the night, no headache, abdomen more distended, pain complained of in each loin, some fulness in right side, aspect not favourable.

Fifty-eight hours after operation the patient was reopened.

There was no sign of peritonitis. The right ureter was first examined and was found distended, ballooned to the size of a forefinger, constricted below; the left ureter presented much the same condition, but was not so much ballooned. The ligatures on the uterine arteries were removed, and the urine flowed out of the ureters into the bladder. The vessels on either side had been caught up with some cellular tissue, and this had evidently caused a kinking of both ureters and complete obstruction. The patient recovered.

2. **Ligature of One Ureter.**—When one ureter only has been ligatured it is extremely improbable that the condition will be diagnosed, for it is quite possible for a patient to progress favourably after an operation when this accident has occurred. We would naturally expect that she would complain of pain in the region where the ligature has been applied, and Fenomenoff's case illustrates this well (see *post*).

Knox reports the following case, apparently operated on by Kelly:

The woman was forty-five years of age. The abdomen was found on examination to be symmetrically distended by a large tumour bulging out in both flanks.

On opening the abdomen a densely adherent unilocular cyst was encountered, from which 19 litres of thin yellow fluid were evacuated. The ovarian and uterine vessels were ligatured. **The patient did well at first, but died suddenly on the eighth day.**

The post-mortem examination showed the mass to be a fibrocystic tumour of the uterus. There was dilatation of both ureters and renal pelves from pressure, together with double pyelonephrosis with abscesses. The **left ureter was occluded by a ligature.**

Fenomenoff, in removing a broad-ligament cyst, cut away accidentally a considerable segment of the right ureter. He was unable to suture the two ends or implant the proximal end in the bladder; he therefore drew the ureter out of the retroperitoneal space, and applied two ligatures as close to the kidney as possible. The patient made a complete recovery without any renal symptoms, save during the first week, when she felt lumbar pain, and the excretion of urine was below the normal. Seven months later the patient was well, but still felt some lumbar pain.

Bardenheuer, in operating on a case of malignant disease of

the pelvis, found the ureter running through the growth. He divided it, and ligatured the proximal end. The patient did well until the eighth week, and then died.

Several reported cases show that occlusion of one ureter is not necessarily a fatal accident. It may give rise to few symptoms, and we may be quite unable to diagnose such a condition during the after-treatment. Guyon goes so far as to express the opinion that, if we cannot join the divided ureter to its distal portion or to the bladder, it is better to tie the proximal and the distal extremities with aseptic ligatures rather than to attempt a nephrectomy on a patient who will not bear a prolonged operation.

Notwithstanding Guyon's advice, the following case shows that ligaturing one ureter is, at times, a fatal complication:

Martin* had occasion to excise four different parts of the wall of the bladder. The patient passed water spontaneously from the first, so that Martin did not think that there was an obstruction to the ureters. The patient died on the seventh day, without feverish reaction, from uræmia, and the autopsy showed the left ureter excessively filled up to the kidney.

Should the opposite kidney be in a diseased condition, the patient may not die from uræmia; she may, however, die from sepsis, inasmuch as her resistance to septic invasion is much reduced, and it is to be noted that in a number of cases where the autopsy showed death from peritonitis one ureter has been found occluded by a ligature.†

Ligature of one ureter only will probably not be diagnosed. The urine will be diminished in quantity, but if the opposite kidney is healthy there will be no albumin and but little blood in the urine.

There will probably be some tenderness on pressure over the kidney and ureter. If a cystoscopic examination is made then no urine can be obtained by introducing the catheter into the ureter on the injured side; too much reliance, however, must not be placed on this last observation, as there may be complete anuria, even though the second kidney is healthy and the ureter free.

An easy way of ascertaining whether one ureter only is discharging urine is to introduce into the bladder Downes's segregator.

* *British Gynæcological Journal*, 1898, p. 190.

† Blumenthal, *Münch. Med. Woch.*, 1898, No. 31, p. 992.

3. **Injury to one or both Ureters.**—We may injure one or both ureters during a section by applying forceps, by piercing with a needle, by partially or wholly severing with the knife or scissors, or by tearing while enucleating adherent or malignant growths.

In some cases the injury is inflicted during the operation, but the ureter does not allow the urine to escape until the necrosed tissue separates four or five days later.

Wertheim, of Vienna, in describing a radical abdominal operation for uterine carcinoma, said that he had lost one case from gangrene of the ureter with ascending suppuration, and he accordingly now leaves the ureter undisturbed in its connective-tissue bed. Any suppuration in the pelvis may lead to a urinary fistula some weeks after the operation.

Symptoms.—The symptoms that we shall be called upon to deal with depend upon whether the urine finds its way into the peritoneal cavity, into the vagina, or escapes upon the cutaneous surface.

If the ureter is injured low down in the pelvis, the urine may escape into the retroperitoneal space, and then after a time find its way down to the vagina.

In a case recorded by Kelly, he mentions that it was necessary to pass a number of ligatures with a needle about bleeding-points in the pelvic floor after enucleating a densely adherent pelvic mass. In doing this it is quite certain that the left ureter was punctured, for a constant dribbling of urine began through the drainage-tube, which lasted for several weeks, and finally ceased spontaneously.

If the ureter is injured high up, and the urine escapes into the peritoneal cavity, septic peritonitis will rapidly develop if the urine is already septic, except in those cases where the ureter is divided low down, and gets fixed in the vaginal cicatrix, so as to establish a uretero-vaginal fistula.

If, however, neither the urine nor the peritoneal cavity contains septic germs, then the urine will be tolerated for some time, and some of it will even be absorbed, as cases reported by Thornton and Kammerer have demonstrated, the latter recording a case where, seventeen days after the ureter had been injured in performing oöphorectomy, signs of peritonitis developed, and on the abdomen being reopened a localized cavity was found containing a large quantity of seropurulent fluid with

a urinous odour. A urinary fistula was established, and later on nephrectomy was successfully carried out.

As the urine cannot be poured out into the peritoneal cavity, or the retroperitoneal tissue, for any length of time without giving rise to trouble, we usually find that the fluid makes its way either to the vagina or to the abdominal incision.

In some cases we have a circumscribed intraperitoneal urinary abscess formed, which in time communicates with the surface, the bowel, or the vagina, and discharges its contents.

Although the ureter may be injured, the urine may not escape for some weeks after the operation. Routier reports a case where, owing to a gangrenous process, a fistula of the ureter into the vagina occurred twenty-eight days after an operation.

Grimsdale* removed a large cystic tumour of the left ovary and a small one of the right ovary. There were many dense adhesions deep in the pelvis and some adhesions to the intestines. Fifteen days later, on account of symptoms of intestinal obstruction, the abdomen was reopened. On the left side of the sacrum some adhesions were separated, and some mucopurulent fluid, with some blood-clot, was set free, and a glass drainage-tube was inserted. The operation caused immediate relief. During the next few days the patient's condition improved, but some watery fluid, which was evidently urine, came through the abdominal drainage-tube and soaked the dressings, also some yellow material that looked like the contents from the small intestine and some gas escaped from the abdominal wound. Some coloured fluid was injected into the bladder, but it did not appear at the wound, so it was concluded that the left ureter discharged into the wound.

A few days later the patient complained of pain in the region of the right kidney, and a movable swelling could be felt there. Urine had been passed very frequently by the bladder, but in very small quantities—about 2 ounces at a time. A large amount, which was estimated at about 1 pint, still came from the abdominal wound.

The kidney tumour increased in size, so an incision was made into the right kidney through the right loin, and about 2 pints of urine escaped. A drainage-tube was put into the kidney.

During the next month the patient gained strength ; the urine

* *Journal of Obstetrics and Gynæcology of the British Empire*, February, 1903.

from the right kidney increased from 20 to 40 ounces per diem, while the amount of urine from the abdominal wound in front gradually became less, and then ceased. Little water entered the bladder, but occasionally urine appeared in the stools.

Two months after the original operation a catheter was passed through the bladder into the right ureter. It passed easily for about $1\frac{1}{2}$ inches, when it was arrested; a stilette was passed into the catheter, and after a time it went about $\frac{1}{2}$ inch further, when it again stopped. The stilette was then withdrawn and the catheter passed right up to the kidney, and urine began to drop from its end. The catheter was fixed in position by a suture placed in the meatus. The catheter was left in position for forty-eight hours and then removed; after this the urine passed naturally, and the wound in the loin healed in four days.

In this case we see that obstruction of the right ureter led to an acute hydronephrosis, while obstruction of the left was followed by ultimate loss of function of the left kidney.

Cripps records a case where, after hysterectomy, the stump was fixed in the abdominal wound. On the twenty-third day a small amount of urine passed by the wound; apparently the right ureter had been opened by the sloughing of the pedicle.

Nussbaum, during an ovariotomy, placed the pedicle in a wire écraseur. This was removed on the eleventh day, and the removal was followed by the passage of a large quantity of urine through the abdominal wound.

Zweifel pointed out that in tying off the broad ligament the ureter may be compressed by the ligatured tissue, and although not included in the ligature, yet necrosis and urinary fistula may follow.

Purcell's case, already related, was an instance of this compression; but here the ligatures were removed in time, and the patient was saved.

In some cases the ureter has been torn or severed at the time of the operation, and the operator has performed uretero-ureteral anastomosis or has sutured the duct. Some days after the operation the ureter gives way, and then urine escapes. Thus Cushing, in operating on a soft myoma of the uterus, completely divided the ureter. He sewed the ends together, but a fistula developed after the fourth day, and did not close for nine months.

Hindley, in removing an abdominal tumour, partially divided the ureter, which he then sutured. Two weeks later a urinous

filtration into the broad ligament was opened from the vagina and drained; while in a case of multilocular cyst of the ovary operated on by Lawford Knaggs, in which the ureter was partially divided, a urinary fistula formed seven weeks after the operation, but quickly closed.

Diagnosis.—If the ureter has been injured, but not divided, the urine will not escape until the necrosed tissue separates; and until we discover that the urine is escaping from the vagina or from the abdominal incision, we are not likely to diagnose an injured, a leaking, or a severed ureter. Once, however, when operating on an immense sarcoma of the left ovary, the hæmorrhage was so severe that our assistant had to compress the abdominal aorta to prevent the patient bleeding to death on the table. In order to remove the growth we had to excise 6 inches of intestine, as the growth completely surrounded it. The ends of the bowel were brought out at the abdominal wound and fixed there, and the patient was placed in bed. In examining the specimen, we discovered that we had removed some inches of the left ureter. As the patient was progressing favourably, we allowed her to remain in bed for five hours, and then reopened the abdominal cavity, found the proximal end of the ureter, and brought it up through the abdominal wound. The patient, however, died twenty-four hours later, death being due to shock and to the amount of blood lost at the time of the operation.

Prognosis and Treatment.—Injury to a ureter must always be looked upon as a grave accident, for even if the patient does not die immediately from the escape of the urine into the peritoneal cavity, her condition with a urinary fistula is often lamentable. These fistulæ do not tend to close spontaneously, except when the division of the ureter is incomplete; and after the fistula has persisted for some time, the patient often dies from ascending septic infection of the kidney, or her life can only be saved by having the kidney removed. Even if she submits to a plastic operation, hydronephrosis may result, and she may have to submit to nephrectomy.

In choosing a plan for treating fistulæ, we should always select the simplest method that presents itself and the one that carries the least risk to life.

We shall not enter into a description of the modes of diverting back to the bladder the urine discharged through the fistula, as

these are to be found fully described in the works of Kelly and Morris.

Injuries to the Bladder.

The bladder has been injured times out of number during the course of abdominal operations. Terillon collected twenty cases of injury to the bladder, and fourteen of these terminated fatally.

The cases that we are concerned with are those in which a urinary fistula forms after the operation.

This may be due to the surgeon wounding the bladder during the course of the operation, or it may be due to the fact that on opening the abdomen the tumour is found to be already communicating with the bladder. Many instances have been recorded where dermoid and hydatid cysts, ovarian cystomata, and extra-uterine fœtal sacs have been found communicating with the bladder at the time of the operation, and as the opening in the bladder may be imperfectly closed, a urinary fistula results, the urine being discharged through the abdominal incision after the operation.

In some cases after operations on pelvic organs which are matted together by chronic disease, no urine escapes from the abdominal wounds for some days after the operation. This is well illustrated in a case published by Ward Cousins.* An ovarian cyst, very adherent, was removed, and a glass drainage-tube was inserted behind the uterus. The patient's progress was favourable until the eighth day, when the urine became very offensive and thick. On the eleventh day there was a sudden and copious discharge of offensive urine from the lower angle of the abdominal wound, which completely soaked the dressings and the bed. Many unsuccessful attempts were made to keep the bladder empty, but the urine continued to escape through the abdominal wound. On the nineteenth day a large slough was found protruding from the urethra, and with the help of forceps it was withdrawn. It measured 12 inches in length, and at the centre about 1¼ inches in breadth. The urine at once escaped again through the normal passage, and in a few days the patient regained complete control over the bladder, and the abdominal sinus healed. Cousins thinks that it is certain that the bladder was not wounded with the knife or torn open

* *British Medical Journal*, May 19, 1900.

in the separation of the base of the tumour, as the urine was discharged for days without difficulty or pain. He thinks that the perforation was caused by one of the ligatures enclosing a portion of the bladder wall, and so arresting the blood-supply, and inducing softening and necrotic changes in a limited area.

H. Smith* records a somewhat similar case. He removed a very adherent ovarian cyst. On the seventh day after the operation the notes record that 'the patient has passed no urine during the last twenty-five hours, and there is a decided urinous smell about the discharge from the wound, which is thin and copious.' On introducing a catheter only 1 ounce of urine was drawn off. The patient continued to discharge urine from the abdominal wound until the twentieth day after the operation, when she died. The autopsy showed that the abdominal wound was healed for three-fourths of its extent. The bladder was found to have a large ulcerated opening at its superior and posterior part large enough to admit two fingers.

Billroth in two of his operations in which there were adhesions to the bladder noticed four or five days afterwards the escape of urine through the abdominal wound, but this ceased after three weeks. Spencer Wells and Kelly record similar experiences.

Mirabeau describes some trophic bladder affections after abdominal operations on the uterus and ovaries, and he thinks that vesical trouble may be due to the rupture of an abscess, the contraction of inflammatory products near the bladder, the passage of a ligature into the bladder, or the ligaturing of bloodvessels supplying its walls; he describes two cases in which lesions were detected by means of the cystoscope.

In a case recorded by Kelly, after an ovariotomy the bladder became overdistended, portions of the mucosa were cast off, and the patient had a high fever and became insane.

Thring,† of Sydney, performed Cæsarean section on a woman, aged fifty-one years, with cancer of the cervix. The anterior division of the internal iliac on the left side and the internal iliac on the right side were tied, and four days after the operation urine escaped *per vaginam*, probably from an opening at the base of the bladder.

* *Lancet*, August 15, 1863.

† *Journal of Obstetrics and Gynæcology of the British Empire*, January, 1903.

Treatment.—The injury to the viscus may be discovered soon after the operation. Thus, in a case recorded by Lourmeau* the tubes and ovaries were removed and hysteropexy performed. After the operation there was occasion to pass a catheter, when it was found that the bladder was evidently wounded. The abdominal incision was opened, and it was then discovered that nearly all the bladder had been accidently excised. A bladder was extemporized that seems to have acted fairly well. Some days later the patient became insane; she was, however, alive two months after the operation.

In cases where the urine is discharged through the parietal wound after a section, we shall first have to discover whether the bladder or the ureter has been injured. If the patient is progressing favourably, let well alone; and if the fistula is connected with the bladder, in all probability it will close during the first few weeks. If it does not close, a plastic operation can be performed, after making a temporary vesico-vaginal fistula for efficient drainage. Thus Wiggin† in removing a large fibroid injured the bladder, and the wound was closed by suture. Ten days later the lower angle of the abdominal wound opened, and urine escaped. A vesico-vaginal fistula was made to insure complete drainage of the bladder; the abdominal sinus was curetted and closed by suture, and the patient rapidly recovered.

* Rohe, *American Journal of Obstetrics*, vol. i., 1899.
† *Journal of the American Medical Association*, September, 1899.

CHAPTER XLII

COMPLICATIONS ARISING IN CONNECTION WITH THE RESPIRATORY ORGANS

INFLUENZA, bronchitis, broncho-pneumonia, lobar pneumonia, and pleurisy have all been recorded as complications after sections. When any of these affections do arise, they cause the patient great distress from the straining on the sutures due to the constant coughing, and they are always serious, as they serve to cause prostration at a time when the patient is in most need of her reserve of strength.

When **Influenza** sets in immediately after the operation it may cause us great alarm, since the temperature frequently shoots up, and the pulse becomes very rapid. In one instance where we had removed the appendages, the patient, who was apparently quite well on the morning of the operation, and had a normal temperature, developed a temperature of 103·5° F. on the evening of the operation. The diagnosis was easily made, because the patient had the characteristic pain in her head, back, and legs, her tonsils were swollen, and she had the clean tongue, with the red enlarged fungiform papillæ, so often to be seen in cases of epidemic influenza.

Influenza exerts no unfavourable influence on the course of the case, except that the short, dry cough which usually sets in on the third or fourth day may cause the patient considerable distress from the constant jerking of the abdominal muscles; and a cough arising from any cause may be a contributing factor towards the formation of an incisional hernia.

In the case of influenza in which the cough is so often merely due to a throat irritation, the best treatment is to constantly spray the throat with menthol (10 grains)—dissolved in paroleine (1 ounce)—by means of an atomizer. For the pains in the head and limbs, antifebrin and citrate of caffeine, in doses of

3 grains each, given every hour for three hours, followed every three hours by salicylate of sodium (7 grains), has been the treatment which we adopted in many thousands of cases during epidemics; and we find, as years go on, no treatment more effectual when we have had to deal with the disease after it has attacked post-operative cases.

Should the case be one of 'abdominal influenza,' it will be difficult to diagnose it from peritonitis. One symptom may be of some use (and this we have frequently noticed during epidemics)—*i.e.*, the presence of an excessively tender zone situated on the left side of the epigastric region close to the cartilage of the eighth rib. Pressure in this region causes the patient to shrink back as much as pressure on McBurney's spot causes the patient trouble who has appendicitis.

Pleurisy* is a rare complication after cœliotomy, but it may develop when the patient becomes septic, and more especially when the septic condition is mild.

Kelly mentions that he had five cases of pleurisy in 1,200 sections.

Pleurisy may be a symptom of pyæmia, and Wells's fifty-ninth case is an instance of this, a friction sound being detected on the twenty-third day after the operation, and the patient died on the twenty-fifth day. The autopsy showed old adhesions of the right pleura, and both old and recent of the left.

An afebrile pleuritic effusion may occur in cases of malignant and non-malignant cystic ovarian tumours, so that after operations on such cases a bilateral effusion will be found, and this may not be absorbed for some weeks (Guiseppe Resinelli).

Bronchitis occurs more frequently than pleurisy, and is due in some cases to the patient being the subject of a chronic bronchial catarrh, which is increased and lighted up by the anæsthetic, especially by ether.

Carelessness in neglecting to properly cover the patient's chest and limbs during the course of the operation, especially during prolonged operations in winter months and when the patient is advanced in years, are the chief causes of this complication. Another source of chill, leading to bronchitis and lung complication, arises from the covering becoming soaked with the irrigating fluids. This causes a rapid loss of heat from the body, since the

* The lymph vessels which run from the abdominal to the pleural cavities can very well serve as channels for bacterial infection.

body actually loses more heat when surrounded by wet clothes than when it has no covering on whatever, because there is the loss of heat by radiation, and there is the loss of heat from the evaporation of the water in the wet clothes.*

In cases when the patient has a 'weak chest' it is advisable to have a cotton-wool jacket made, to be worn at the time of the operation and for some days afterwards.

In some cases, when bronchial catarrh appears to be due to the irritation of the anæsthetic, a free use of atropine after the operation has given us satisfactory results.

Broncho-Pneumonia and Croupous Pneumonia.—Kummell in 1,070 laparotomies has reported forty cases of pneumonia, with twenty-nine deaths.

Henle † has made a study of 1,787 laparotomies performed in Mickulicz's clinic.

He found that pneumonia followed the operation 143 times, and of these cases sixty-five died. This gives a morbidity of 8 per cent., with a mortality of 3·6 per cent. Most of the cases were of the lobular type. In the majority of instances the pneumonia appeared on the second day, less frequently on the third, fourth, and first days. A most important predisposing factor is the age of the patient. Of over 100 patients upon whom cœliotomy was performed at an age between eleven and twenty years, 3·4 per cent. developed pneumonia, while of those over seventy years 27 per cent. developed pneumonia. Men were affected somewhat more frequently than women. In those cases in which gastro-enterostomy was performed for carcinoma the percentage of pneumonia rose to 14, with a death-rate of 9 per cent., while only 9·5 per cent. of those patients upon whom gastro-enterostomy was performed for a benign stenosis suffered from pneumonia, and none of them lived. The anæsthetic is undoubtedly sometimes responsible for the pneumonia; but in certain classes of cases, notably after gastro-enterostomy and resection of the stomach, local anæsthesia is more often followed by pneumonia than is general anæsthesia. Henle explains this by saying that, while narcosis is somewhat damaging, it is less so than pain, excitement, and weakness of the heart, which are apt to be the accompaniments of a serious operation if only a

* Hale White, *Lancet*, July 3, 1897.

† *Centralbl. f. Chir.*, July 20, 1901; extract in *Progressive Medicine*, June, 1902.

local anæsthetic is employed. Of all predisposing causes chilling of the patient is probably the most important. Since special care has been taken in Mickulicz's clinic to keep the patient warm during the operation the percentage of pneumonia has gradually declined from 8 per cent. to 10 per cent. in 1898, to 6·6 per cent. in 1899, and 3·6 per cent. in 1900, this last reduction having been accomplished by the giving up of the prolonged washing of the patient upon the operation-table with water, alcohol, etc.

Stolper has pointed out that the pneumonia which follows laparotomies may be due to fatty embolism, the result of tearing and bruising fatty tissues.

While the pneumonia which occurs after a section may be due to exposure during the operation and the irritation from the anæsthetic, it may also be due to pyæmia, or inhalation of septic contents during the operation.

In all cases where the patient becomes septic after the operation and survives for more than a week, the base of the lungs should be examined from time to time to ascertain if there is any consolidation. When this is done we may soon have an explanation for the alarming variations in the temperature chart. Whenever evidence of pneumonia is found in septic cases the prognosis is more than grave, and we must be liberal in our use of carbonate of ammonia, digitalis, and strychnine.

While septic pneumonia has been frequently known to arise after operations for ileus, it perhaps arises occasionally after sections, when no septic matter is present. Thus Shaw* records a case where, on removing an ovary, the patient had very persistent vomiting and retching after the operation. The temperature remained normal until the fourth day, when it rose to 100° F. The patient then began to have a very bad odour in the breath, and she was troubled with a cough, and the temperature rose to 102° F. The lungs were examined, and just above the nipple some very curious sounds were perceived—sometimes they were harsh leathery friction, sometimes coarse rhonchi, and sometimes all abnormal characters disappeared. There was no tubular breathing or other evidence of consolidation. After this the patient coughed up some blood and mucus of a most fœtid character, and from this time forward she improved. Shaw considers that this was a case of septic pneumonia arising from the persistent vomiting after the operation.

* *British Gynæcological Journal*, 1896, p. 97.

CHAPTER XLIII

PULMONARY EMBOLISM—HEART CLOT

Pulmonary Embolism.

EMBOLISM has occurred after the most simple abdominal operation, such, for instance, as a hysteropexy; while its occurrence after operations on fibroids of the uterus accounts for 2 per cent. of deaths after abdominal hysterectomy.

Michel* collected 586 cases of abdominal hysterectomy in which there were 13 deaths from embolism. He also collected 209 cases of vaginal hysterectomy with 7 deaths from the same cause, and 25 cases of myotomy with 3 deaths.

We may take it for granted that pulmonary embolism is almost always consecutive to thrombosis of the pelvic veins or of the veins of the lower extremities, and that while the thrombus may occasionally be present before the operation, it usually forms as the result of the operative procedure, and that sepsis plays a large part in the production of post-operative thrombi.

Symptoms.—The patient may be attacked by the train of symptoms presently to be described soon after the operation is completed, while, on the other hand, the symptoms may not arise until some weeks after the operation.

Thus Martin and Bouilly both report cases when the symptoms set in the day after the operation.

Delagenière reports the occurrence of the symptoms on the second day; Pozzi and Wyder on the fifth day; Lequeu on the sixth day; Wehmer on the ninth day; Weiss on the tenth. Other observers have reported the occurrence on the fourteenth, fifteenth, twenty-first, twenty-sixth, and thirty-first days after the operation.

* Michel, 'De L'Embolie Pulmonaire' (*Revue de Gynécologie et de Chirurgie Abdominale*, Pozzi, 1900, p. 627).

Frequently some slight exertion on the part of the patient is the cause of the detachment of the embolus. Thus, in a case which happened under the eyes of Harrison Cripps the embolus was detached through the exertion following on the change of the dressings.

Smyly says: 'I lost a case from this accident during the third week after operation. She had been sitting by the fire talking to the other patients, and was in the act of pulling off her boots, when she was suddenly seized with a feeling of suffocation, precordial anxiety, gasping respiration, cyanosis, and died in a few minutes.'

Duncan lost a case on the eighteenth day when the patient was just about to leave the hospital.

In one of Kelly's cases the patient awoke from a sleep and complained of pain in her leg. The nurse rubbed her vigorously. 'Suddenly the patient gave a sharp cry, and complained of frightful roaring in the head and a feeling of suffocation. The pulse quickly became weak and intermittent, the breathing spasmodic, and within a few seconds she died.' Even after the patient is moving about weeks after the operation, and apparently quite well, she may succumb. Thus, in a case recorded by Reclus the patient whilst walking across the courtyard of the hospital, apparently quite convalescent, dropped dead.

With regard to the symptoms that have been observed in these cases, the outstanding fact is the suddenness of the seizure.

The patient, who may have been progressing favourably, undertakes some slight exertion, such as coughing or turning in bed, when suddenly she is seized with extreme dyspnœa, although the air enters the lungs freely. The countenance becomes blanched or livid, the lips darken, the cervical veins swell, her face expresses the greatest anxiety, while her intelligence is unimpaired, and she is quite conscious that something dreadful has happened. Her eyes are in a condition of exophthalmos and the pupils dilate, while her face, covered in a cold perspiration, expresses the fear of impending death.

The pulse runs up almost immediately to 140 or more, and as if struggling to overcome the obstruction in the pulmonary artery, the heart's action is irregular and tumultuous, and soon becomes feeble, the patient expiring in a few minutes, sometimes in convulsions.

While this is the unfortunate termination in the majority of these cases, happily they do not all terminate thus.

In a case where we removed a fibroid, leaving only the cervix, the patient progressed favourably until the seventh day. Suddenly she was affected with dyspnœa, while her pulse ran up to 160. We were immediately summoned, and on arriving found the patient lying with her head low, her face and lips blue; her pulse could not be counted. The heart was racing along with a most irregular beat. We placed a thermometer in her mouth, and could feel that her breath was very cold, and on withdrawing the thermometer found that it registered 93° F. We tried another thermometer, but got the same result. In the axilla the temperature was a little below normal. The patient was given a hypodermic injection of strychnine, and she gradually improved, although the pulse remained very rapid. Two days later, not fully appreciating her true condition, and thinking that the cervix was causing some septic trouble, we risked placing the patient on the operation-table, and ether having been administered, we rapidly removed the cervix, swabbed the parts with peroxide of hydrogen, and drained with iodoform gauze, after which she gradually improved until the nineteenth day after the first operation, when she developed phlebitis in the left leg, and a week later her neck swelled, first on one side then on the other, and was very painful for several days.* She eventually recovered, and is now quite well.

In some cases the patient may have one attack and recover, only to have a second seizure, in which she may succumb. In one of Olshausen's cases 'on the eighth day during a passage from the bowels the patient had an attack of vertigo, oppression, coldness of the limbs and face, syncope, small and frequent pulse. On the twelfth day another attack occurred and terminated fatally. The autopsy showed embolism of the right and left pulmonary arteries.'

Diagnosis and Prognosis.—The diagnosis is made from the extremely sudden appearance of the symptoms, taken in conjunction with the knowledge that thrombosis may be present in

* Playfair has recorded a case where chest symptoms denoting embolism first appeared fourteen days after a confinement; two days later phlegmasia dolens of a severe kind developed, and, 'shortly after the first appearance of the paroxysms, it was observed that the cellular tissue of the neck and part of the face became swollen and œdematous.'

the extremities or pelvis. But the thrombosis may be latent, and we may be in doubt if the attack is but a mild one, and if the patient continues to improve from day to day. Here the embolus, if it exists, is so situated that the collateral circulation through the pulmonary capillaries is sufficient, the lung being happily insusceptible to partial local anæmia. In such cases the pulse always has a high rate, and the patient is incapable of the least exertion. She cannot breathe readily in the recumbent position, and may have to be propped up with pillows. The air, however, enters the lung with great facility, while the heart-sounds may be feeble and the heart's action tumultuous.

In some cases when the patient does not die immediately the embolism is followed by hæmorrhagic infarction of the lung. This is illustrated by a case recorded by the Keiths as one of 'heart clot' after ovariotomy; the symptoms point to pulmonary embolism and infarction. It was noticed that 'in the afternoon there was a very slight recurrence of the chest symptoms; pain was complained of, the face became slightly cyanosed, and the pulse rose to 100. Next day the pulse had fallen to 86. In the evening the temperature was 100·4° F., and the patient was troubled with a tickling cough with slight frothy expectoration. Until April 11 (operation March 19) the evening temperature was usually about 100° F., but on that evening it rose to 102° F., and the expectoration become slightly rusty. There was no marked increase in the respiration, and the pulse was from 80 to 90.'

When the symptoms set in a few days after the operation, the extremely rapid pulse and respiration and the low temperature may tempt us to think that we are dealing with a case of secondary hæmorrhage. In a case of Howard Kelly's, where a ligature slipped off the uterine artery after a hysterectomy, the patient had been progressing favourably until the eighth day. 'At noon of that day she suddenly cried out, and when the nurse hurried to her she complained of great pain in the left inguinal region. Her pulse was very rapid and her expression anxious. A resident at once hurried to the ward, arriving there in fifteen minutes; but by this time the pulse had become imperceptible, and the patient was in a dying condition. The collapse was so sudden that the diagnosis of pulmonary embolism was made.'

Treatment.—Prophylaxis may be of some real use if we bear in mind Weyder's advice to make a careful examination of the circulatory system before undertaking any section, and if with a frequent pulse we find hard veins which are painful on pressure, or if the lower extremities are œdematous, then we should refrain from operating until the œdema has subsided and the veins show less signs of phlebitis. We may also bear in mind Mickulicz's caution not to operate on a patient whose hæmoglobin is under 30 per cent., or even when it is 45 per cent., which is the lowest limit for other operators.

If during the course of the operation we discover thrombosis of the veins of the broad ligament, we must be careful not to allow the patient to exert herself in any way for weeks after the operation; for Weyder, Wehmen, and Buschbeck have all recorded fatal cases of embolism following sections, during which they discovered thrombosed veins in the pelvis.

Even if these vessels are not thrombosed, but only dilated and varicose, we must take increased care. Thus Flaischlen, in removing a fibroid from a very anæmic patient, noticed that the veins were unusually large. He therefore ordered the utmost repose for three weeks after the operation. She was then allowed to sit up, but soon after developed all the symptoms of pulmonary embolism, which was followed by pneumonia. Eighteen days later the patient felt well, and was allowed to sit up; three days later, however, in stooping to pull on her boots, she was again attacked with symptoms of embolism, and nearly expired. After four weeks' rest she recovered.

Mather, and after him Weyder, have drawn attention to the pulse-rate as a symptom that may warn us of latent thrombosis. If, therefore, we find after an operation that the pulse-rate is exceedingly rapid, while the temperature remains normal and the patient appears to be doing well, and if this state of things continues, the pulse tending to increase still more in rapidity, while the temperature is persistently low, then we may suspect latent thrombosis. In some cases, with this increase of pulse-rate there will be an increase of the leucocytes in the blood-count. Some observers have remarked that there is a characteristic softness of the pulse, but this has not been generally observed. There may also be localized pelvic pain on one side of the uterus, although a careful examination discloses no cellulitis to account for it.

Lastly, remembering that embolism is much more frequent after operations on fibroids—eighteen out of a total of forty-three cases reported—we must pay particular attention to such cases if they are markedly anæmic after the operation.

In many cases the surgeon will seldom see the patient during the attack, as death occurs with such rapidity; but in cases when the patient survives we must administer, hypodermically, stimulants such as strychnine, ether, or ammonia, and inject brandy and ammonia by the bowel. The patient should be surrounded by hot bottles, and a mustard-leaf may be placed over the heart. If she is very restless $\frac{1}{6}$ grain of morphia may be injected.

During the succeeding days there must be absolute repose, and the patient is to be warned that any exertion on her part may cause another attack, which may end fatally, as we have seen in the case recorded by Olshausen. The recumbent position, liquid food, pills of jalapine and enemata to prevent straining at stool, and stimulants to whip up the flagging heart, are all remedies that will aid us in a fight against a complication which Weyder truly describes as a 'thunderbolt in a clear sky.'*

Heart Clot.

A very small percentage of the deaths that take place after sections may be justly put down to pulmonary embolism. A still smaller percentage may be due to primary thrombosis in the pulmonary artery or in the heart itself.

We may illustrate these cases by some reported by Sir Spencer Wells.

In one case the patient, aged thirty-five, was operated on for an ovarian cyst which had already been tapped three times. She progressed well for twenty-four hours, but after that complained of pain in the abdomen, and on the third day the pulse rose from 104 to 130, and by evening it was 140.

In the forenoon of the fourth day the pulse went up to 150; the skin was hot and dry in parts, sweating in others. Flatus

* Since writing the above, we opened a woman's abdomen, and found that she had extensive malignant disease of the liver. Nothing was removed. The abdomen was closed, and the patient progressed well until the evening of the ninth day, when, after turning in bed, she was suddenly seized with dyspnœa, her face became cyanosed, she tried to sit up in bed, and after a few struggles she expired three minutes from the onset of her symptoms No autopsy was allowed, but it was probable that death was due to embolism

passed freely. The wound healed except where the ligature emerged, and some clean reddish serum was sucked out from along the ligature track. The pulse now rose to 160, and the first sound of the heart was inaudible. Five grains of carbonate of ammonia were given in champagne every hour, but the pulse became more feeble and fluttering, the extremities cold, and she died eighty hours after the operation.

The autopsy showed that the pericardium contained about ½ ounce of serum; the right auricle contained a little black imperfect coagulation; the right ventricle also contained some of the coagulation, as well as a firm, adherent fibrinous coagulum. The clot was grooved, and passed down from the pulmonary artery and through the auriculo-ventricular opening into the right auricle, where it was surrounded by the black imperfect coagulum. The clot adhered very closely to the columnæ carneæ and to many of the chordæ tendineæ, being, as it were, twined round the latter. The left auricle and ventricle were free from clots.

The abdominal cavity showed that there had been diffused peritonitis.

Wells says: 'This case was watched with great interest, as I suspected the commencement of fibrinous clot in the heart at least twenty-four hours before death, and at least eight hours before death Dr. Richardson defined the precise spot in which the coagulum was found.'

In another case the patient's pulse was 140 after the operation, and then ran to 168. She was very restless, and complained of great oppression at the heart, and faintness. She died ninety-two hours after the operation, and a tough fibrinous clot filled the right ventricle and extended into the pulmonary artery.

Wells says: 'I looked upon the case from the moment of the operation as one of clot in the heart. The very rapid, irregular, pulse, the vibration rather than contraction of the heart, the absence of the usual sounds, the flushed face, the cold extremities, the laboured respirations—all pointed to the same conclusion.'

Symptoms and Diagnosis.—If the thrombus is small it will probably cause no symptoms, unless it escapes from the heart and causes pulmonary embolism.

Unless the orifices are encroached upon, the mere presence of large thrombi usually occasions little or no disturbance of the heart, or none which can be distinguished from that of associated

valvular or mural disease (Welch). If the thrombus encroaches on the orifices of the heart, it may occasion murmurs.

As so few cases of heart clot have been described as occurring after abdominal sections, we may refer to cases that have occurred after labour to help us in elucidating the signs that point to this condition.

In a case reported by Playfair in which he believed a heart clot formed after a confinement, he noticed that 'immediately over the site of the pulmonary arteries there was a distinct harsh, rasping murmur confined to a very limited space, and not propagated either upwards or downwards. The heart-sounds were feeble and tumultuous.' In this case the least excitement brought on the most aggravated dyspnœa, and she panted and struggled for breath.

In another of Playfair's cases there had been two attacks of dyspnœa. Three weeks after labour the case was examined by Broadbent, who found a bruit indicating thrombosis in the right auricle. A few days later there were symptoms of embolism of a branch of the pulmonary artery leading to the lower part of the left lung—namely, impaired resonance, imperfect entry of air, and loud, harsh friction. The auricular murmur was no longer audible, but there was a systolic murmur over the pulmonary artery and obscuration of the pulmonary second sound, the coagulum interfering with the proper closure of the valves. Broadbent's interpretation was that there was extension of the thrombus from the auricle into the ventricle and pulmonary artery, and consequently embolism of a branch of the pulmonary artery (Galabin).

Prognosis and Treatment.—The prognosis in cases when we suspect a heart clot is very serious. The patient must be kept at rest, for should she exert herself in any way a portion of the clot may be detached, and a fatal result occur, or pulmonary hæmorrhagic infarction may follow.

The treatment to be adopted will be the same as that described for pulmonary embolism.

CHAPTER XLIV

HEART COMPLICATIONS AFTER THE REMOVAL OF ABDOMINAL TUMOURS

B. Fenwick,* in a paper read before the British Gynæcological Society in 1886, described the pathological condition of the heart in eighteen cases in which death had resulted from some form of abdominal tumour.

Hofmeyer † and Kessler ‡ have each recorded cases where death took place, more or less suddenly, after sections performed on cases for myoma of the uterus.

The question has therefore arisen whether there is any connection between the heart affection and the abdominal trouble; and if so, whether any complications arise in the after-treatment as a result of the heart condition.

It would appear that in the case of myoma of the uterus the change in the heart is directly due to the presence of the myoma. It has been urged that the cardiac degeneration in the case of bleeding fibroids is due to the resulting anæmia. But Brosin has pointed out that in cases where the patient bleeds on account of carcinoma of the uterus, we may have no signs of cardiac degeneration even after years. Again, it is a remarkable fact that the change in the heart may occur even quite early, when the myoma is small and the general condition of the patient good.§

Strassmann and Lehmann found that in a series of seventy-one cases of myoma some affection of the heart was present in 40·8 per cent.

* *British Gynæcological Journal*, May, 1887.

† *Zeitsch. f. Geburts. u. Gynäk.*, 1885, vol. ii., p. 366.

‡ *Ibid.*, Band xlvii., Heft 1, p. 77.

§ Wilson, *Journal of Obstetrics and Gynæcology of the British Empire*, June, 1902.

Doran* and Wilson† have dealt with this subject, and the latter brings forward evidence to show that in a certain not inconsiderable number of patients who have fibromyomata of the uterus of only moderate size, serious organic disease of the heart is present. Sometimes the cardiac affection has been present before the fibroid began to grow, in which cases the heart symptoms are apt to be made worse. In a large number of cases the heart disease is secondary to the growth of the uterine tumour, and arises in one of two ways—either the tumour may lead to menorrhagia and so to anæmia and malnutrition of the heart, or hypertrophy of the heart may at first be set up in a way that we do not at present understand.

In either case the ultimate result is dilatation of the cavities, and fibroid and fatty degeneration of the walls of the heart.

Where the tumour has been of great size, whether it has been a fibrocystic tumour of the uterus or a cystic tumour of the ovary, the pressure exerted by such on the pleural cavities interferes with the oxygenation of the blood, and this may be followed by fatty degeneration of the heart. When the tumour is situated in the liver, as we have observed in cases suffering from hydatid cyst of the liver, the pressure on the heart itself and on the afferent and efferent vessels causes at times a most serious cardiac condition, and this is aggravated by the tumour sometimes pressing on the ureters, and so leading to renal degeneration, which in turn leads to further cardiac changes.

When a patient is operated on who is suffering from some cardiac trouble, the result of the presence of an abdominal tumour, the after-treatment may be complicated by the patient suffering very severely from shock, or attacks of palpitation and dyspnœa, while in other cases the patient may show signs of sudden collapse, from which she is rallied only with great difficulty, and in some cases sudden death occurs when the patient is apparently progressing well.

In one of Wilson's cases the patient suffered very much from shock after both ovaries had been removed to check the growth

* Doran, 'Fibroids and Heart Disease' (*Journal of Obstetrics and Gynæcology of the British Empire*, January, 1903).

† Wilson, 'The Relation of Organic Affections of the Heart to Fibromyoma of the Uterus' (*Transactions of the London Obstetrical Society*, vol. xlii., 1901).

of a myoma. For nine days after the operation the breathing was very hurried, while in spite of careful nursing a bedsore formed over the sacrum a few days after the operation, and this persisted for over seven weeks. In another of his cases the cardiac failure after the operation was very marked, and on the ninth day there was femoral thrombosis. In a third case death occurred on the tenth day from perforation of a latent duodenal ulcer; post-mortem examination showed brown induration and fatty degeneration of the heart muscle.

Kessler records a case where he operated on a woman aged fifty-four years, and removed a myoma weighing 60 pounds. After a severe and anxious operation the patient appeared to be progressing favourably, when she was allowed by the nurse to sit up in bed, and she immediately fell back dead.

The post-mortem showed that death was not due to embolism. The heart was examined, and the appearances characteristic of myofibrosis were found. The left ventricle was much hypertrophied.

Prophylactic Treatment.

If we are called upon to perform a section in a case in which the heart shows signs of organic mischief, we may deem it necessary to postpone the operation for weeks, or even months. In some cases the treatment will be directed towards the anæmia, which may be due to loss of blood, as we so often find in cases of fibroid disease of the uterus. We have employed tabloids of suprarenal capsule in such cases with excellent results. With regard to ergot, it must be borne in mind that this drug may produce alarming symptoms, such as breathlessness and palpitation and a species of pseudo-angina pains, the symptoms being, no doubt, due to the tightened up arteries offering increased resistance to the enfeebled heart.*

If the cardiac trouble is due to a cystic tumour, such as a hydatid of the liver, it may be considered advisable to withdraw some of the fluid from the cyst so as to relieve the pressure, and thus enable the patient to regain enough strength to undergo the major operation at a later date.

* The same effect may occur after the operation, and in one of our cases the injection of ergotin brought about the most profound collapse on two occasions.

In one of our cases where the patient, a woman, had a large hydatid cyst of the liver, we were compelled to keep her in bed for three months before the operation could be performed. Her heart was displaced, and she was very feeble and anæmic. She could not take the slightest exertion without the most distressing dyspnœa. Her urine was loaded with albumin, and her legs swollen with dropsy and covered with large varicose ulcers. She was treated with a milk and farinaceous diet, and was given digitalis and acetate of potash.

At the operation the hydatid cyst was found, but the liver substance had to be cut through to the depth of 1 inch, and in doing this some enormous venous channels were opened; the bleeding could only be controlled by stuffing the wound with iodoform gauze. The patient was placed back in bed, and as she rallied she was operated on again next day, when the cyst was tapped and treated according to Lindermann's plan. She remained in bed for two months, and ultimately her heart and kidneys greatly improved. A year later she returned to the hospital, as the varicose ulcers in the legs were again troubling her. Her heart had much improved, and there was no albumin in her urine.

At the time of the operation increased care must be exercised with these patients, and every precaution taken to minimize the loss of blood and loss of heat so as to prevent shock. Strychnine and adrenalin may be administered, but care should be taken not to embarrass the heart with the last drug. The anæsthetic should be ether rather than chloroform, and the saline transfusion apparatus should be in readiness, and carbonate of ammonia and brandy may be required by the bowel.

After the operation the patient should be treated as one suffering from shock, and every care should be taken lest she should assume the upright position too soon, for this, as we have related above in Kessler's case, may be followed by sudden death.

We should also bear in mind that thrombo - phlebitis is especially liable to occur in these cases, while, as we have seen in one of Wilson's cases, bed-sores may form and cause the patient much pain.

In some cases where before the operation the patient has been

subject to marked irregularity of the pulse, this after the operation gradually disappears.*

In an elderly woman whose heart is affected before the operation we frequently have a great diminution in the quantity of water passed after the operation, and in some cases we may have almost complete anuria, which is followed by an abundant secretion.

* Chavannaz and Fieux, *Revue mensuelle de Gynécologie, Obstetrique et Pædiatrie de Bordeaux*, March, 1900, p. 186.

CHAPTER XLV

THROMBO-PHLEBITIS—THROMBOSIS OF THE MESENTERIC VESSELS

Thrombo-Phlebitis.

Thrombo-phlebitis of the veins of the pelvis and extremities occurs from time to time after sections, and gives cause for anxiety when recognised, in view of the fact that a thrombus must always be regarded as a potential embolus.

The phlebitis may occur in the pelvic veins after a hysterectomy for fibro-myoma or after ovariotomy, but it is of much more frequent occurrence after the former operation. Taking all cases into consideration, some amount of thrombo-phlebitis may be diagnosed in 1 per cent. of all sections which deal with the pelvic organs.

Thrombosis may occur after the operation has been performed, or it may exist before the operation; thus Gros found very extensive thrombosis of the broad ligament while operating on a case of fibroid of the uterus (Michel).

The mere fact that we have thrombosis in the pelvic vessels after a section does not in itself constitute a danger, inasmuch as there is abundant evidence to show that when the uterine vein, for instance, is ligated thrombosis occurs in that vessel back to the main vein. This, in fact, may be looked upon as a normal event. The exact cause that turns the normal condition into a pathological one is not rightly understood.

Mayet* and others consider that the main factor in the causation of thrombo-phlebitis is an alteration in the walls of the pelvic vessels due to micro-organisms; and in the case of fibroids of the uterus we may easily get an infection of the veins

* Michel, 'De L'Embolie Pulmonaire' (*Revue de Gynécologie*, Pozzi, 4, 1900).

before the operation from the endometritis so often present in such cases.

Alteration in the nutrition of the vessel wall, or an injury to it, chemical change in the blood itself, and local alteration in the rate of the current, are all to be taken into consideration as factors in the causation. In the case of fibroids of the uterus we can readily see how these latter factors are brought into play when we consider the pressure exerted by a large tumour on the vessels whose endothelium is affected by change in the circulation of the vasa vasorum. Then there is the slowing of the stream, the profound anæmia often verging on chlorosis, accompanied by a fall in the specific gravity of the plasma.

If the thrombosis does not occur until after the operation, then the chief factors will be alteration in the composition of the blood due to hæmorrhage at the time of the operation, added to perhaps an already existing anæmia, especially when there is marasmus or cancer present. There is, besides, the injury to the veins during the operation.

But above all factors must be placed sepsis, which is undoubtedly the chief factor in the majority* of cases, especially when the thrombosis does not occur until weeks after the operation. The veins in the broad ligament having become infected, a thrombo-phlebitis begins; the entrance of the bacteria, the chemical changes in the blood set up by the infection, and the toxic condition, are the immediate factors in the production of the thrombo-phlebitis in the contiguous veins, such as the ovarian, iliac, or femoral.

Should a stitch abscess form, branches of the superficial and deep epigastric veins may be the channels along which the infection spreads to the femoral and iliac vessels.

With regard to the frequency of the complication, Burkhard found that in 236 myoma operations thrombosis occurred in 12 cases, and in 18 cases of ovariotomy it occurred twice.

Symptoms.—If the blood-clot in the vessels is sterile, the symptoms present are not sufficient to attract any attention. If, however, the clot becomes infected, the pain and swelling on the side affected will allow us to diagnose the condition.

* 'Phlebitis following operations for fibroids is quite common. It is the tendency of surgeons to attribute all accidents following operation to infection, but in many cases of phlebitis following hysterectomy and myomectomy the rôle of infection is difficult to prove or believe' (Noble).

The symptoms do not usually develop until the second or third week. Coe found that they often set in suddenly about the tenth day. Kelly says that he has had this complication nine times in 1,200 cases, and in five of the cases it occurred on the twenty-second day. In one of the first ovariotomies performed—in the year 1843—by Walne, it is recorded that the patient progressed very well until the ninth day after the operation, when she began to complain 'of considerable uneasiness in the left iliac region, with one tender spot feeling like an intestine in a state of contraction'; next day the leg became swollen and painful, and a thrombo-phlebitis was discovered.

As recorded in this case, the patient may be progressing quite favourably, when she will one day complain of pain either in the region of the femoral vein, close to the groin, or the pain may start in the calf, as it did in three of our own cases. The pulse becomes accelerated to 120 to 130, and the temperature rises to 101° to 102° F., and the patient may have a slight rigor. The limb becomes swollen, and any movement causes pain, while the patient becomes irritable and complains of feeling ill and thirsty, and the tongue soon becomes furred. If a blood-count be made we shall see a considerable increase in leucocytes.

Œdema may be slight, or the whole limb may become swollen, and so excessively painful that the patient can neither turn in bed nor allow the limb to be moved, while the weight of the bedclothes is too much for her; the pain is out of proportion to the lesion, and Sampson regards it as due to the stretching of the walls of the bloodvessel.

At times it may be possible to feel the affected veins running like hard cords beneath the tender skin, which may now become red over the course of the inflamed vessel.

If it has been a unilateral operation the phlebitis may be on the side of the operation, or it may be on the opposite side, or on both.

After the acute symptoms the leg remains swollen, but the tenderness gradually begins to decrease after a few weeks, though the patient is unable to put the foot to the ground for a month or even longer after the attack, and then the ankle and leg will swell with the slightest exertion.

In one of our own cases, after removing a very large ovarian cyst uncomplicated by any adhesions, the patient progressed satisfactorily until the third week, when she was seized with

pain in the groin, and the whole leg became an immense size, and resembled a phlegmasia dolens. She was unable to leave her bed for another month, and when she left the hospital, although all pain had left her, the leg continued swollen and wooden, and remained so for months after. We do not know if it ever regained its normal size.

In another of our cases after hysterectomy for a large fibroid the symptoms set in on the nineteenth day, the patient having had already all the symptoms of pulmonary embolism ; the calf of the left leg and the foot became very painful and swollen, but the swelling and pain disappeared in the course of six weeks, although she was subject to attacks of pain and swelling off and on for some considerable time after she was convalescent.

Twice lately we have had this complication : in the first case after performing inguinal colotomy, followed by Kraske's operation for the removal of the rectum ; in the second case after operating on a pelvic hydatid cyst. Both of these cases became septic, and this led to the condition ; both recovered.

Diagnosis.—Pain in the region of the thrombosis is the first thing to attract the patient's attention. On making an examination, we may be able to detect some swelling in the leg or some œdema, while a vaginal examination has shown in some instances some induration in the broad ligament. After a day or so the leg shows distinct signs of swelling.

Considerable stress has been laid on what is known as Singer's and Mahler's sign. The former maintains that the pulse is rapid from the outset of the case, and does not drop with the temperature on the third or fourth days, and that it rises sharply about the eighth day, and is highest on the ninth day when the symptoms of thrombosis become manifest. Burkhard found the acceleration of the pulse, without a coincident rise in temperature, in 75 per cent. of his cases. We noticed the continued rapid pulse in two of our cases.

Kelly remarks that 'with the phlebitis of the femoral vein I would also associate a group of cases characterized by the same symptoms—pain coming on about two weeks after operation, elevated temperature and tenderness passing off slowly—in which, however, the discomforts are felt entirely in the pelvis on one side, and there is no evidence of any cellulitis or peritonitis upon making a vaginal examination.'

Prognosis.—If the phlebitis attacks the veins of the leg about

the calf, the prognosis is good; but if the thrombo-phlebitis has extended along the uterine veins to the iliac or femoral vessels, or along the ovarian vein to the vena cava, the prognosis is more serious, owing to the greater facility with which the clots may gain entrance to the vena cava, and so to the pulmonary vessels. Duncan lost a case on the eighteenth day from embolism, which had its origin in the left internal iliac vein.

Time is of importance in the prognosis if we are to judge from what occurs in puerperal cases, where it is seldom that embolism occurs until the third week after the labour, when the clot has become soft and brittle. Again, we do not expect embolism after six weeks have elapsed; nevertheless, Thiersch reports a case where the patient had three attacks of pneumonia—nine days, six weeks, and five months respectively after an abdominal operation, all evidently due to emboli (Olshausen).

Thrombosis may develop in one femoral vein, and later on be followed, as in a case recorded by Duncan, by thrombosis in the femoral vein of the other leg.

Treatment — PROPHYLACTIC. — It has been suggested that in patients with a weak circulation the compression excited upon the femoral or long saphenous vein by the abdominal binder may help to cause this complication. Lennander,* who had had this complication after several abdominal sections, placed his bandage in such a way that no pressure could be exerted on these veins; yet nevertheless thrombosis occurred, involving sometimes the long saphenous and femoral veins and also the external iliac. He then adopted the plan of raising the end of the bed to a height of from 4 to 20 inches in all cases after abdominal or hernial operations. The bed was kept elevated during the entire stay of the patient in the hospital. Besides this measure heart tonics were administered when the heart's action was weak, and shortly after the operation passive movements and light massage of the foot and leg practised.

The result of these precautions is that Lennander has had but a single case of thrombosis since 1897, and this was the only case when the foot of the bed had not been raised!

In all cases where the patient is very anæmic, or where there is pus in the pelvis, we strongly advise that the foot of the bed be kept elevated after the operation.

* *Centralbl. f. Chir.*, No. 19, 1899.

Therapeutic.—The patient must be kept strictly to bed; the foot of the bed is raised. She should not be moved on to a couch, for we must again repeat that a thrombus is a potential embolus.

Over the region where the patient complains of most pain hot boracic foments should be applied every hour, while the rest of the leg may be enveloped in cotton-wool. The foot should be elevated on a soft pillow, and the leg steadied on a splint or by means of sandbags. If the boracic foments give no relief, lint soaked in a hot solution of lead and opium may be tried; while glycerine and belladonna, smeared on lint, have given us excellent results. Half a dozen leeches will often relieve the pain very markedly, while Kelly says that the Paquelin cautery lightly touched over the inflamed line often affords relief.

The bedclothes should be kept from pressing on the limb by means of a cradle, and if the patient suffers great pain morphia may be freely injected.

When the acute symptoms have abated and the temperature has fallen, the affected part may be treated with great advantage with potassium iodide and soap liniment smeared on chamois leather, and we have found the Tallerman hot-air bath of service.

Massage should be avoided, but elastic pressure may be tried during the fourth or fifth week if the limb is slow in regaining its normal size.

As the patient may be much reduced in strength from the long confinement in the one position, great care should be taken lest bed-sores develop.

If the patient gives a history of previous attacks of rheumatic fever, salicylate of soda in large doses will act with excellent effect, as we have seen lately when treating a case of pelvic inflammation in which both legs were attacked with thrombophlebitis.

Thrombosis of the Mesenteric Vessels.

After abdominal operations we on very rare occasions have symptoms that point to thrombosis of the mesenteric vessels. Thus Billroth, after performing an ovariotomy, found that at the end of the first week after the operation the patient had developed a temperature. Grave collapse, the result of a profuse intestinal hæmorrhage, then developed suddenly. The patient long hovered between life and death, but finally recovered.

The case was diagnosed as embolism of the superior mesenteric artery (Olshausen).

In the section on 'Perforation and Gangrene of the Intestines,' we have quoted a case recorded by Burkhard where, after a supravaginal hystero-myomectomy, the bowel was found perforated, and the inferior mesenteric vein was thrombosed throughout its entire course.

As this complication is a very rare one, we shall abstract from a paper by Maylard* a full description of two cases of post-operative thrombosis, one occurring after a section, the other after excision of the left half of the thyroid gland :

'**Case 1. Gastro-jejunostomy for Symptoms of Pyloric Obstruction; Death on the Fourth Day from Thrombosis of the Mesenteric Vessels.**—Miss X., aged twenty-six, was a patient of Dr. Shiels, Glasgow, by whom I was asked to see her.

'History.—Her symptoms, dating back for two years and a half, were mostly gastric in character, and pointed unmistakably to some obstruction at the pylorus. There was a ventricular systolic murmur with a well-marked *bruit de diable* in the veins of the neck. Her pulse was invariably rapid, and frequently registered 120. She was anxious that something operative should be undertaken to relieve her of the incessant vomiting which always followed after taking solid food.

'Operation.—On July 4, 1901, in St. Elizabeth's Private Nursing Home, with the assistance of Dr. Grant Andrew and Dr. Russell, with Dr. Holm Henderson as anæsthetist, I performed gastro-jejunostomy without any difficulties. Anastomosis was effected by stitching. The patient took the anæsthetic well, and the operation, which included a preliminary exploration of the stomach, was completed in fifty minutes.

'After-History.—After the operation the patient was somewhat restless, with rapid pulse, otherwise she seemed well. On the second day flatus was passed *per rectum.* On the third day all seemed to be going on well till the afternoon, when she became extremely restless, tossing herself about so violently that she had to be forcibly held in bed. The nurses in charge thought the patient was hysterical in her behaviour. On the fourth morning pain was complained of in the lower part of the abdomen, where

* 'Two Cases of Post-operative Thrombosis of the Mesenteric Vessels followed by Death' (*British Medical Journal*, November 16, 1901).

there was also tenderness on pressure. The injections of nutrient enemata caused great pain, and were immediately expelled. There was no abdominal distension and no parietal rigidity. Wind was occasionally belched up, but there was no marked vomiting. There was continued great restlessness, accompanied with considerable breathlessness. The pulse was very rapid and weak. Features much sunken in aspect. The patient died from increasing exhaustion.

'Post-mortem Examination.—As no permission was obtained for a general post-mortem examination, Dr. John Duncan made an examination of the abdominal contents through the original parietal incision. The substance of his report was as follows: Everything connected with the operated-upon parts of the stomach and intestine were in a perfectly sound and healthy condition; there was not the slightest evidence of peritonitis anywhere. On tracing the small intestine downwards, it was found perfectly healthy until the last 3 feet of the ileum were reached. These 3 feet were of a dark purple colour. The involved gut itself was empty and collapsed. The mesenteric vessels in connection with it were found to be thrombosed as far up as they could be seen and felt in the mesentery. The great bowel, appendix, rectum, uterus, Fallopian tubes, ovaries and bladder, were examined, but presented no abnormality.

'**Case 2. Excision of the Left Half of the Thyroid Gland; Death Three Days after the Operation from Thrombosis of the Mesenteric Vessels.**—The patient, Mary Y., aged twenty-eight, a governess, was under the care of my colleague, Dr. Ebenezer Duncan, in the Victoria Infirmary.

'History.—She was being treated for exophthalmic goitre accompanied with the usual symptoms. The following remarks are abstracted from the report of her case when admitted into the medical ward: "A distinct thrill is felt over the vessels of the neck. On auscultation a roaring ventricular systolic murmur is heard. A fainter ventricular systolic is heard over the tumour. Ventricular systolic heard down the sternum (getting fainter) and over the whole cardiac area. Second sound rather wanting in sharpness. Pulse is very weak and soft, and numbered 126 per minute."

'Operation.—On July 9, 1901, at the request of Dr. E. Duncan, and with the assistance of Dr. Grant Andrew, Dr. Russell, and Dr. John Duncan, I excised the left half of the gland. The removal

was effected with very little loss of blood, and the patient rallied well and rapidly from the operation.

'After-History.—During the night of the operation she became very restless and excitable, but this was attributed by the nurse to the excessive heat of the season.

'*July* 10.—During the morning the bowels became very loose, and fluid motions were passed, one of which was noted to be distinctly tarry in colour, and believed to contain blood. The succeeding motions were of a greenish colour. In the afternoon she began to complain of pain at the lower part of the abdomen, unaccompanied with tenderness on palpation or with any distension or rigidity of the parietes. She was not troubled with vomiting, and nourishment in the form of milk was taken freely. Her most marked symptoms were increasing restlessness and excitability, so much so that those in charge considered she was simply hysterical. Her temperature, which the day before had risen to 100·8° F., now began to fall; and the pulse, always more or less rapid, became increasingly so and more feeble. These symptoms continued until the next morning (12th), when the patient died at 4.30 in a collapsed condition. Nourishment was well taken up till death. Towards the end the abdomen showed some signs of distension.

'Necropsy.—The necropsy made by the pathologist, Dr. Anderson, revealed the following conditions: The ileum from about its commencement to the cæcum was of a dark purple colour, almost black at parts, and here and there showed evidences of sloughing. General distension, with a smooth, shiny appearance of the serous coat, was, however, the most marked condition of the gut. On opening the ileum, its contents were found to be fluid blood and undigested food. The mesenteric veins were thrombosed, and numerous hæmorrhages were visible beneath the peritoneum. The heart was small, soft, and pale; no valvular lesions. The lungs were congested, and full of œdema; the bronchi were markedly injected. The liver was soft and anæmic, with small superficial hæmorrhages. The spleen was passively congested. The kidneys were small, but pale on the cortices.

'In reviewing these two cases together the following points of similarity appear in connection with the clinical symptoms: Both patients were females, and of about the same age—one twenty-six years, and the other twenty-eight years.

In both there was a ventricular systolic murmur; in both there was rapidity of the pulse as a symptom prior to operation, and a continuance, with increased rapidity, after operation. In both there was excessive excitability occurring on the second and third days after the operation, which, although the patients were in different institutions and under different capable nurses, were considered by these as symptomatic of hysteria. In both the pain at the lower part of the abdomen suggested commencing peritonitis, but in neither were there other symptoms typically suggestive of it. In both cases death occurred at pretty much the same interval of time after operation, and in both the mesenteric vessels connected with the ileum were the ones found thrombosed. In both the wounds connected with the operations were perfectly healthy.

'The following were the points of dissimilarity: In the pyloric case, although flatus was passed, there was no passage of fluid motions containing blood, as in the exophthalmic. A marked feature in the pyloric case was the great pain caused by any attempt to inject, *per rectum,* nutrient enemata. Immediate expulsion followed the effort. A marked difference existed in the extent and degree of involvement of the bowel; in the pyloric case only about 3 feet of ileum were congested, the bowel was collapsed, and did not contain blood; in the exophthalmic case the whole ileum was implicated, densely congested, ecchymosed, distended, and in places showed signs of sloughing, and in its interior contained fluid blood.'

Maylard concludes his paper with the following remarks:

'I have looked up the records of such cases as have been published, and find that while there is much variation in the severity of the symptoms as they appear at the onset and throughout the course of the disease, there are not wanting those which seem to be more or less characteristic. Thus (1) intra-abdominal pain is invariably present, sometimes commencing acutely, at other times gradually and with no more discomfort than is manifested by a sense of uneasiness. In not a few instances the pain has been colicky in character, sometimes located in the region of the umbilicus, at other times low down in the abdomen. (2) The passage of loose stools sometimes containing blood. This symptom is an uncertain one, and seems to depend upon the extent of bowel involved and the degree of its congestion. It is, however, when present an unquestionably

valuable diagnostic sign. (3) Vomiting is also a very inconstant symptom, and seems, in like manner, to be dependent upon the degree and extent to which the bowel is thrown out of action by its impaired vascular supply. It is the presence of this symptom which so frequently causes these cases to be taken as instances of acute intestinal obstruction, and which to a certain extent they are, although a wrong cause is usually ascribed to them. (4) The general condition of the abdomen is, as a rule, negative; there is neither rigidity, tenderness, nor distension, although towards the close of the case the latter may become more or less manifest. (5) The pulse, which has sometimes remained more or less normal in power and speed, is in most cases weakened and increased in rapidity. (6) The temperature presents no certain character, although in the severe cases it is usually reduced. (7) A symptom which has been noted in not a few instances has been great excitability of the nervous system. In my own two cases it was present to a remarkable extent, and suggested, as already stated, that the patients were hysterical. It is possible that the symptom has only a very indirect connection with the disease, and is merely an accident, which arises from a constant sense of pain and discomfort acting upon a naturally overexcitable nervous system.

'In conclusion, I am disposed to think that the following symptoms, when occurring within a few days after an operation, may be taken as suggesting post-operative thrombosis of the mesenteric vessels, and more particularly so when the operation was not one involving the intestines:

'1. The onset of intra-abdominal pain, gradual or acute, but more or less constant, and possibly of a colicky character.

'2. Neither tenderness on palpation of the abdomen, nor distension, nor rigidity of the parietes in the earlier stages.

'3. Possibly diarrhœa with or without blood.

'4. Possibly vomiting, but not of the usually acute obstructive character.

'5. Rapidity of pulse.

'6. Undue and inexplicable restlessness and excitability.

'7. Any pre-existing symptoms of cardiac or vascular disease may be considered to attach additional weight to the significance of the other symptoms.

'In searching for references of thrombosis of mesenteric veins, I have been unable to find any record of a case following upon,

or dependent upon, operation. Those given below are limited to such as were of a more or less uncomplicated character—that is to say, cases which manifested very definite symptoms the result of the thrombosis.

'Recorded Cases of Thrombosis of the Mesenteric Veins.

'Payne, *Path. Soc. Trans. Lond.*, vol. xxi., p. 228; Fagge, *ibid.*, vol. xxvii., p. 124; Taylor, *ibid.*, vol. xxxii., p. 61; McWeeney, *Dublin Journal of the Medical Sciences*, 1894, vol. xcvii., p. 169; Delatour, *Annals of Surgery*, 1895, vol. xxi., p. 24; Bradford, *Clin. Soc. Trans. Lond.*, 1898, p. 203; Johnson, *ibid.*, 1898, vol. xxxi., p. 212; Köster, *Deut. Med. Woch.*, 1898, p. 329; Ballance, *Lancet*, 1899, vol. ii., p. 85; Welch, "Allbutt's System of Medicine," 1899, vol. v., p. 218; Johst, "Inaug. Dissert.," Königsberg, 1894. Johst also gives abstracts of the following recorded cases: Choquet, *Bull. de la Soc. Anat.*, 1878, s. 124; Pilliet, *Prog. Méd.*, 1890, No. 25; Eisenlohr, *Jahrb. der Hamburger Staats Krankenanstalten*, 1890, ii. 2, p. 76; Dreyfous, *Bull. de la Soc. Anat.*, 1885, p. 274.'

CHAPTER XLVI

ULCERATION, PERFORATION, AND GANGRENE OF THE INTESTINES—INTESTINAL HÆMORRHAGES

Etiology.

Ulceration of the Intestines may be present at the time of the operation, or it may occur after a section, and may lead to perforation of the bowel or intestinal hæmorrhage.[1]

In some instances the ulceration occurs as the effect of obstruction of the bowels, while in other cases it may be due to thrombosis of the intestinal vessels. In one case that we know of it was apparently due to the Bright's disease that the patient was suffering from at the time of the operation.

Bland-Sutton investigated a case where the patient died eight days after the removal of an ovarian dermoid. At the autopsy several ulcers were found in the jejunum, one of which, situated 6 feet from the duodenum, had perforated and caused fatal peritonitis. There had been no symptoms of obstruction at any time, or any evidence to lead to the supposition that there was disease of the intestines.

Doran* reported a case to the Pathological Society of London of a patient, aged twenty-six years, from whom a large suppurating ovarian cyst had been removed. The posterior wall of the cyst had become firmly adherent to the last 6 inches of the ileum. On the evening of the eighth day after the operation the patient was seized with severe epigastric pains and became collapsed, dying in a few hours. The peritoneal cavity was found full of fluid fæces, which proceeded from an ulcerated aperture in a portion of the bowel, which had become slightly adherent to the abdominal wall. The ulceration was met with some distance above the part of the ileum which had formerly been adherent to the ovarian cyst, but which had now become

* *Lancet*, February, 1879.

matted to other coils, and by the distension of the gut above had become sharply twisted, leading to almost complete obstruction. Doran considered as there was no enlargement of Peyer's glands that the ulceration was due to simple inflammation in a debilitated patient, increased by obstruction beyond; the perforating ulcer was 12 inches above the point of obstruction.

Goodhart, in discussing this paper, said that, with regard to the production of the perforating ulcer, although in Doran's case it might have been due to simple distension of the bowel, yet sometimes they depended on obstruction of vessels in the mesentery. This is illustrated by the following case recorded by Burkhard:*

A woman, aged forty-one years, had supravaginal hysteromyomectomy performed. She died on the twenty-first day after the operation.

The autopsy showed a rather widespread peritonitis, which was most marked about the splenic flexure of the colon, infarcts of the left lung, and hypostatic pneumonia. At the point of most acute peritonitis there was a perforation in the splenic flexure. Numerous ulcers were also found in the colon. In the ileum there was marked hyperæmia of the mucosa, with here and there grayish-yellow necrotic areas, and in the lower end there was cicatricial thickening. Liver and kidneys were acutely inflamed. The inferior mesenteric vein was thrombosed throughout its entire course, and out into the vena cava and the splenic vein. There was also thrombosis in the left iliac vein, which extended down into the femoral vein. The pelvic and hæmorrhoidal veins were filled with thrombi, and there were also adherent thrombi in both renal veins. The field of operation was free from inflammatory changes. It appears from the autopsy that the intestinal lesions were secondary to the thrombi of the mesenteric vessels. The sudden onset of renal symptoms was unquestionably secondary to the thrombus formed in the renal vessels.

Adams† reports a case in which he removed a suppurating ovarian cyst from a patient aged thirty-three. The adhesions were very firm, especially towards the rectum. The patient appeared to be doing well for the first twenty-four hours, but died on the third day. At the autopsy there was found sup-

* Clark, *Progressive Medicine*, June, 1901.

† *British Medical Journal*, September, 1882.

purative peritonitis, suppuration along the course of the wound, and a gangrenous patch near the middle of the rectum about the size of a shilling, which had perforated in two places. The damage to the rectum was evidently of some weeks' standing, judging from the discoloured appearance around, and explained the suppuration of the cyst and the fatal result, though whether it was due to direct pressure of the gut or to thrombosis of the hæmorrhoidal vessels could not be determined.

We were present at a Cæsarean section performed by Foreman,* of Sydney. The patient died on the twelfth day from sepsis. The autopsy showed that the intestines near the wound were healthy looking, but were stuck together by slight adhesions. In the right lumbar region the ascending colon and small intestines were adherent to the abdominal wall and to one another. On pulling these away from the wall, areas of gangrenous intestines were found, while most of the intestines in this region were very unhealthy looking.

Another Cæsarean section performed in Sydney about this time also ended fatally, and a perforating ulcer was found in the ascending colon. The patient had advanced Bright's disease.

In some cases where a duodenal ulcer is present we may get a profuse hæmorrhage after a section. Howard Kelly mentions three cases of intestinal hæmorrhage, one of which occurred in his own clinic. It followed an operation for a left pyosalpinx, containing from 20 to 30 c.c. of pus, produced by a streptococcus infection. While the patient was being operated on the abscess burst, and she died in four days of an extensive intestinal hæmorrhage, with a septic peritonitis. The autopsy showed the presence of a round ulcer of the duodenum 18 millimetres in diameter, and an erosion of a small vein 1 millimetre in diameter, while the large and small intestines contained immense quantities of soft reddish coagula, estimated at about 2 litres.

Billroth reported a case in which the temperature rose a week after ovariotomy had been performed. A profuse intestinal hæmorrhage occurred, and the patient collapsed, but finally recovered. Billroth considered that this was an instance of embolism of the superior mesenteric artery.

In one of his ovariotomies Kaltenbach was compelled to discontinue the operation, but before closing the abdomen he discovered that he had ruptured the adherent intestinal walls.

* *Australian Medical Gazette*, October, 1900.

This was repaired, and the patient recovered, but a few months later a profuse intestinal hæmorrhage occurred. No further history was obtained.

In one of our cases a fæcal fistula formed from a coil of small intestine adhering to the abdominal wound, which suppurated. Six weeks after the operation the patient passed $\frac{1}{2}$ pint of blood-clot *per rectum*. This evidently came from the edge of the fistula.

Symptoms and Treatment.

If the patient complains of constant and severe pain in the region of the hepatic or splenic flexure of the colon, and the stools are offensive, and she has attacks of diarrhœa, we may, if those symptoms continue, suspect ulceration of the large intestine. We believe it was present in the following case: We removed a large fibroid by abdominal hysterectomy, and the patient during the second week developed symptoms of pulmonary embolism, followed by thrombo-phlebitis and parotitis. During the second and third weeks she complained of a constant gnawing pain below the liver and along the course of the ascending colon, and her stools then became most offensive, and whenever a motion was passed the patient endured great pain from the scalding, the parts about the anus being very excoriated from the motions. The patient recovered, the motions becoming gradually less offensive. We gave her every four hours a capsule containing salicylate of bismuth, benzol, naphthol, salol, and calomel, and the bowels were washed out every day with lime-water.

Twice lately we have had instances of gangrene of the colon after cœliotomy.

In the first case we removed a portion of the stomach, pancreas, and great omentum for malignant disease in a patient aged seventy-three years. He progressed well until the fourth day, his temperature and pulse being normal. On the morning of the fourth day the nurse administered a large salt-water injection, and immediately he complained of great pain in the epigastric region. During the course of the day a very disagreeable smell was observed about the dressings, and on these being removed some dark fluid escaped from the wound. Some of the stitches were removed, and some iodoform gauze was pushed down between the edges of the wound to serve as a drain. On the evening of the fifth day we reopened the abdomen, and found that a portion of the transverse colon had become gan-

grenous, probably from some of the vessels in the mesocolon being tied during the course of the operation. The patient died some hours later.

In another case, a woman of seventy-two years, we removed a portion of the ascending colon, the cæcum, and some of the small intestine, and finished the operation according to Paul's method. The patient progressed well until the eighth day, when she suddenly collapsed and died. At the autopsy a large patch of gangrene was found on the ascending colon.

In both these cases the same dark fluid like strong tea was present, and the smell was that characteristic of gangrene.

Colibacillary Infection.

Vautrin, of Nancy,* reports three cases of fatal infection from the *Bacillus coli communis* after hysterectomy. The operation involved the entire removal of the uterus, the closure of the vagina from above, and abdominal drainage. The first patient, aged forty-four, died on the twelfth day; the second, aged forty-seven, on the eleventh; and the third, aged forty-nine, on the seventh. Milder cases of this form of infection are not rare; the pulse becomes quick, the temperature rises, there is slight tympanites without tenderness, dry tongue, and often jaundice. After a day or two fœtid diarrhœa sets in, and the patient recovers. In these cases the loose stools are found full of colonies of the *Bacillus coli*, whilst that germ is not to be detected in blood taken from the basilic vein. In bad cases, like the three reported by Vautrin, fever sets in early; but, as in streptococcus infection, the pulse rises proportionately much higher than the temperature, and soon assumes a very unfavourable character in every respect. Distension of the abdomen seems never absent, but it is not so extreme as in septic peritonitis, and flatus may pass in considerable quantities; indeed, the tympanites often subsides before death. Vomiting is very marked from the beginning, when it soon becomes bilious to near the end, when it usually grows fæculent. Loss of appetite is complete, and thirst intense. Deglutition becomes painful, as the œsophagus participates in the inflammatory changes which attack the gastro-intestinal tract. The tendency to suppression of urine is very strong, and the scanty renal secretion becomes charged with

* *Revue de Gynécologie et de Chirurgie Abdominale*, November and December, 1901; *British Medical Journal*, Epitome, January 18, 1902.

bile pigment and globules of pus. Diarrhœa is the rule, and it causes improvement in the purely abdominal symptoms, but its onset implies infection of the blood; hence the meaning of collapse and death in cases incorrectly diagnosed as 'septic peritonitis' after flatus has passed, distension subsided, and free action of the bowels established. In all Vautrin's cases blood drawn during life from the basilic vein was found to contain the *Bacillus coli*. There is often a total absence of any sign of peritonitis in these cases, but the whole gastro-intestinal tract is in a state of congestion, with patches of ecchymosis, and ulceration of Peyer's patches is not unknown. It was distinct in Vaudrin's second case. Naphthol and purgatives are good prophylactics in the preparation of patients for abdominal operations; the former not only destroys the bacillus, but also suppresses fermentations. When infection has set in after operation a purgative is indicated, to be assisted by enemata if necessary. Injections of saline solution are needed, but they are often inefficacious in bad cases; and Vautrin hopes for the discovery of an antitoxin which will counteract *Bacillus coli* infection as Marmorek's serum acts on the streptococcus.

CHAPTER XLVII.

POST-OPERATIVE HÆMATEMESIS

Hæmatemesis has been observed to follow ovariotomy and other abdominal operations. We have notes of five cases, two of which occurred in our own practice, and the other three in the practice of colleagues.

In the first case the patient was a very stout woman, aged fifty-one years, on whom abdominal hysterectomy had been performed. Twenty-one hours after the operation 'black vomit' set in, and continued at intervals for seven hours; then bright-red blood was vomited at intervals during three hours. After this there was dark-brown vomit, and occasionally red vomit, and then the vomiting ceased. The 'red and black' vomit continued altogether for eighteen hours. The patient recovered.

The second case was after a section for double pyosalpinx. There was a small quantity of blood and much black vomit during the first twenty-four hours. The patient recovered.

The third case was one of appendicitis in a boy who had been ill for a month before the operation. He had well-marked peritonitis. The abscess was opened and drained, and next day he vomited ½ ounce of bright-red blood. He died in a typhoid condition two days later.

The fourth case was one of pelvic abscess. The patient died after a cœliotomy on the fourth day from peritonitis. She vomited blood for a short time on the second day.

The fifth case was a woman, aged forty-six, who had suffered with chronic indigestion for six months. She felt some abdominal pain, and when we came to examine her we found a fulness just over the pubes. This increased so rapidly in size that forty-eight hours later the swelling had reached the umbilicus.

On the abdomen being opened, free fluid was found in the

peritoneal cavity, and peritonitis was present. Two ovarian cysts were removed, both being soft and œdematous, one especially from twisting of the pedicle. They were malignant growths.

Eighteen hours after the operation she vomited several ounces of black fluid. When examined in a porcelain dish the fluid was found to be as black as very strong coffee. When the dish was tipped up there was a sediment composed of a fine brown granular matter intermingled with short, thin brown fibres about 6 millimetres in length. Under the microscope the fluid was found to be composed of a brown granular material, intermingled with which were red blood corpuscles. The patient vomited this dark fluid several times.

Death took place forty hours after the operation, and an autopsy was conducted a few hours after death. The bowels were not distended and were not adherent, but there were traces of localized peritonitis that had been present at the first operation. The stomach was divided into two compartments by a malignant growth which had commenced on the posterior wall of the stomach. On opening the viscus about 2 ounces of dark fluid was found, and the walls of the cardiac compartment were found to be studded with numerous small bright-red spots due to dilated capillaries. There was no ulceration, but there were two intensely injected areas the size of a shilling close to the ring formed by the growth. Death was due to exhaustion, aided perhaps by the peritonitis, which had not progressed, but showed signs of retrogression.

Mayo Robson, Winslow, Mansell-Moullin, Von Eiselsberg, Reichard, Rodman, Croom, and others have published observations on this subject.

Mayo Robson says that he has seen capillary hæmorrhage from the stomach follow operations from intestinal obstruction, tuberculous peritonitis, cholecystotomy, choledochotomy, hernia, ovariotomy, and simple exploratory laparotomy.*

Von Eiselsberg† has reported eight cases of post-operative hæmorrhage from the stomach and duodenum, some of these being after abdominal operations. In one of his cases the patient was a fat woman, aged fifty-nine, who had a strangulated umbilical hernia; radical operation performed; hæmatemesis

* *British Medical Journal*, March 10, 1900; *Lancet*, February 9, 1901.

† *Arch. f. Klin. Chir.*, vol. lix., part iv., 1899.

second day; recovery. In another case of strangulated umbilical hernia in a very fat woman of sixty years, numerous hæmorrhages were noticed in the mesentery. Hæmatemesis occurred the night after the operation; recovery. In a man aged forty-two the operation was for strangulated hernia; the omentum was deeply ecchymosed. He vomited over a pint of blood on the second day, and death occurred shortly afterwards. Recent ulceration of the duodenum and stomach was found at the autopsy. In two of Von Eiselsberg's cases no blood was vomited, but it was found in the stomach and intestines.

Winslow operated on a stout woman, aged sixty-five years, for umbilical hernia. Death occurred from profuse gastrorrhagia on the third day. The autopsy showed no vascular lesion of the stomach whatever.

Profuse hæmatemesis occurred in a young man, aged twenty-three, operated on by Mansell-Moullin,* who only made an exploratory incision in the left iliac fossa. Death took place in forty-eight hours.

Occasionally the hæmorrhage occurs into the intestinal canal instead of into the intestines.

Howard Kelly mentions three cases, one of which occurred in his own clinic.

Etiology.

Von Eiselsberg tried to explain this post-operative hæmorrhage as a result of injury to the omentum, as in several of his cases the omentum had been ligatured, or there had been torsion of the omentum.† In our fifth case related above we noticed that at the time of the operation the omentum could not be found, and at the autopsy it was seen to consist of a very thin fold stretching between the stomach and transverse colon. It was accordingly not handled or interfered with during the operation.

General anæsthesia has been advanced as a cause, but Mayo Robson points out that he operated on a gall-bladder under cocaine, simply exposing it through a small incision, yet violent hæmatemesis set in the day after the operation.

Rodman, in his oration before the American Medical Associa-

* *Lancet*, October 20, 1900.

† Laceration of the mucous membrane of the stomach from the dragging of an omental hernia has been reported by Rokitanski; while twisting the omentum may cause multiple gastric hæmorrhages.

tion (June, 1900), advanced the theory that sepsis is the cause of these hæmorrhages. Croom also takes this view. But in answer to this, some cases that have been examined—post-mortem—showed no signs of sepsis whatever.

Violent vomiting may have some influence, but the hæmorrhage may occur, though there may have been no vomiting after the anæsthetic (two cases).

Mayo Robson considers that post-operative hæmatemesis was not generally recognised until he drew attention to it in his Hunterian lectures. Its occurrence has long been known. Wilson Fox* thus alludes to it: 'In other cases, though probably referable to the same source, its mode of origin is less explicable, as when it follows severe surgical operations'; and in a note to this he says: 'A case of this nature was communicated to me by my friend and colleague Mr. Berkeley Hill, when after an operation severe hæmatemesis occurred, for which after death no cause could be discovered. Sir W. Jenner informs me that he has seen similar instances.' In Spencer Wells's twenty-sixth case he notices that on the day following the operation 'the sickness did not abate; she continued to throw up large quantities of coffee-coloured fluid, and gradually sank exhausted in the afternoon of the second day after the operation.' The post-mortem showed nothing but turbid serum in the peritoneal cavity; 'it was clear that death took place from exhaustion, partly the result of the uncontrollable vomiting.'

We have quoted this case from Wells because we consider that the black vomit met with after cœliotomy, whether on the first day or at a later period, is due to hæmorrhage; and, consequently, hæmatemesis, far from being an uncommon occurrence, has been in the past and is now a frequent complication, and we consider that the following considerations may throw some light on the subject:

Hæmatemesis may occur as a complication of a large number of affections—scurvy, yellow fever, cholera, cirrhosis of the liver, vicarious menstruation—without any lesion of the lining membrane being discovered after death; consequently, we need not imply for one moment that post-operative hæmatemesis means that the patient's stomach is ulcerated. On the other hand, we cannot so readily admit that, because with the naked eye at the autopsy no lesion can be discovered, none is present; for,

* 'Diseases of the Stomach,' p. 205, 1872.

as Brinton long ago remarked, 'that amongst the myriads of these minute tubes present the eye fails to detect the exact vessel, or vessels, involved in the lesion is, of course, not very surprising.'*

Mansell-Moullin † was called upon to operate on a case for hæmatemesis. One very small bleeding-point was found in the posterior wall of the stomach near the pylorus, and he remarks that 'it was a mere erosion, and did not deserve to be called an ulcer, and I cannot help thinking how easy it would have been to have overlooked it altogether if the inspection had been made after death, when there was no blood escaping from it to act as a guide.'

Beach has reported a case where, after opening the stomach and clearing out the clots, he perceived that the blood oozed from a large part of the inner lining, as it might from a granulating surface. It was easily stopped by pressure, but as soon as the pressure was removed the oozing began again.

We may, then, grant that blood may escape from the mucous membrane of the stomach without a discoverable lesion being present, the corpuscles escaping by diapedesis.

We would suggest that the chief cause of hæmatemesis after cœliotomy is shock through causing a portal congestion.

If we consider Robson's and Eiselsberg's cases, we shall see that while some had general anæsthesia, some local anæsthesia, some had sepsis, while in others this was absent; some there were in which the gall-bladder was operated on; others in which the uterus, tubes, omentum, and other abdominal organs were manipulated, and the only one factor common to all is **shock**, and this acts in the following way: Any abdominal operation causes a reflex dilatation of the abdominal vessels, and an overfilling of the abdominal veins. Now, the blood-supply to the stomach is so arranged that a large number of very slender arteries start up from the large vessels in the submucosa, and as they run between the glands they break up into very fine capillary vessels, and they end in a *much coarser* capillary network around the mouths of the glands. The veins that collect the blood from this capillary network are remarkably few in number, though of far greater diameter when compared to the arterioles. It follows from this arrangement of the vessels that anything that tends to cause an obstruction to the outflow of the blood in

* 'Diseases of the Stomach,' p. 67, 1859. † *Lancet*, October 20, 1900.

the veins leading from the stomach will tend to cause the coarse capillary network surrounding the mouths of the glands to become dilated.

Now, in abdominal shock, the liver* and the superior mesenteric veins, as well as all the other veins leading to the liver, are gorged with blood, and this necessarily hinders the emptying of the gastro-epiploica dextra and other veins coming from the stomach, and this portal engorgement is further increased in all conditions in which there is restricted movement of the diaphragm.

Thus we have produced a condition of portal obstruction which leads to a venous congestion of the walls of the stomach, and so to a diapedesis and an exudation of the fluid into the stomach.

Kehr, in one of his gall-bladder operations, was unable to perform cystostomy. The parts of the lower border of the liver on either side of the gall-bladder were carefully sutured to the parietal peritoneum, after which gauze was placed along the gall-bladder. During the first twenty-four hours after the operation the patient vomited much blood. Kehr remarks that 'we have not infrequently seen these disturbances of the circulation of the portal system after operation upon the liver and bile system. We at first believed that the cause was to be imputed to the tampon upon the choledochus and vena porta. Yet we saw it in cases in which the tampon was not employed.'†

It may be urged that if shock is the chief cause of post-operative hæmatemesis, then we should have this complication more often after operations other than cœliotomies. But our answer to this is that while we get shock after other operations, it is chiefly in abdominal operations that we get this disturbance of the portal circulation, and Crille and others have laid some emphasis on this fact.

As, however, we do not get hæmatemesis in every case of shock after cœliotomy, we must grant that shock and an altered portal circulation are not sufficient to account for the hæmatemesis; and we must therefore suppose that there must be some predisposing conditions present, and these conditions may be either local or general. Such conditions would be ulceration of the stomach or duodenum, or, if ulceration is absent, some breach

* 'Leber und Pfortaderkreislauf sind strotzend gefüllt' (Gottlieb).

† Kehr, 'Gall-stone Disease,' translated by Seymour, p. 187, 1901.

in a vessel wall. Of the general conditions we know less, but if we are to regard the black vomit that occurs during peritonitis as due to the escape of blood corpuscles from the vessels, then septic peritonitis is to be regarded as one of the most important conditions that predispose to hæmatemesis ; and we must suppose that the intercellular or cementing substance of the endothelial cells undergoes a change, and more readily permits the corpuscular elements of the blood to pass through.*

'It must not be supposed that hæmorrhage by apoplexy (or rupture) is always large, or hæmorrhage by diapedesis always small. A rent in a capillary or a vein may give rise to no great loss of blood, while the hæmorrhage from long-continued diapedesis may reach an alarming magnitude. In a given case it is often by no means easy—often, indeed, quite impossible—to decide whether hæmorrhage has occurred by rupture or by diapedesis' (Ziegler).

Mayo Robson has said 'that the only explanation that seems at all feasible is that the hæmorrhage is dependent on a reflex nervous influence.'

We would say that the hæmatemesis that follows cœliotomy is due to an alteration in the circulation of the abdominal vessels, which results in a venous congestion in the gastric walls, and this leads to a rupture of the capillaries or a diapedesis of the blood corpuscles, and this escape of blood is favoured by the presence of sepsis.

Symptoms.

The patient may begin to vomit blood soon after the operation, or not until some days have elapsed.

If the amount of blood that escapes is large, then the blood vomited may be bright in colour; but if the amount is small, and it has remained in the stomach for some little time, then the gastric juice acting on the corpuscles breaks them up, and the hæmatin causes the dark coffee-ground appearance of the blood when it is vomited. In one of the cases in which we examined the dark fluid just after it had been vomited, it was so black that when held to the light in a glass it was quite opaque. When placed in a dish a brown sediment is seen at the bottom when the dish is tilted, and when this is examined by the microscope it is found to consist of brown granular masses, intermingled

* If toxins are excreted by the stomach, the cells may be injured in the process, and a necrosis thus set up.

with which are blood corpuscles; the whole readily gives the reactions for hæmatin.

In the cases that we have observed the amount of blood vomited has never been alarming; but in some of the cases that have been reported, the blood has been vomited in such large quantities that the patient has bled to death.

Prognosis.

The prognosis is grave in all cases where post-operative hæmatemesis is present. Croom remarks: 'Except peritonitis, there is no symptom to be more dreaded than hæmatemesis.'

Mayo Robson lost a case on the third day, a violent hæmatemesis having set in the day after the operation.

Mansell-Moullin's case died within forty-eight hours, though the operation was only a simple exploratory incision in the iliac fossa.

Halliday Croom reports that eight out of ten of his cases died.*

Winslow's case died on the third day after the operation.

Reichard performed a cholecystenterostomy, and this was followed by hæmatemesis on the sixth day, the patient dying two days later.

Kehr remarks that the prognosis is good in the cases in which the pulse remains strong.

Treatment.

Tripier recommends high injections of hot water at a temperature of 112° to 116° F., and these have been employed with success in some cases.

Free purgation with calomel may be tried, and small doses of the tincture of the perchloride of iron or hazeline may be administered, but these must not be persevered with if they cause increased vomiting.

We should strongly recommend the administration of suprarenal capsule with chloretone, or 10-minim doses of adrenalin every hour for three hours.

Morphia may be injected into the epigastric region, and ice may be applied to this region, while a flannel wrung out of mustard-water may be wrapped round the patient's feet.

The patient should be fed by bowel, and given nothing by the mouth except a little ice to suck or a few spoonfuls of ice-cream.

* *British Gynæcological Journal*, May, 1902.

Kehr treated his cases by washing out the stomach with a solution of soda, but remarks that, since the soda solutions dissolve the coagula, in order to encourage coagulation he washed out the stomach with 1 in 1,000 solution of silver nitrate, which was followed by a lavage of ice-water. He also gave enemata of ergot three times a day.

Reichard has operated on two cases where, after the primary operation, the hæmatemesis occurred as though due to gastric ulcer. Gastrotomy failed to reveal any source of bleeding, and both patients died ; the autopsy in both cases showed no lesion.

Mayo Robson is opposed to operative treatment, and thinks that it can rarely be feasible or advisable.

CHAPTER XLVIII

EXTRAPERITONEAL HÆMATOCELE

An extraperitoneal effusion of blood by the side of the uterus occurs more often after cœliotomy than we would suppose, if a judgment is to be formed from the scanty reference to the condition to be found in papers dealing with the after-treatment of section cases. Even in well-known text-books the subject is often not alluded to.

We have encountered this complication in other surgeons' practice, and we have noted its occurrence in some of our own cases. It is probable that when the amount of blood poured out is small, it causes but a slight disturbance, and it is overlooked or regarded as an attack of 'cellulitis'; when, however, the effusion is larger, it is impossible for it to be mistaken for anything else.

Tait repeatedly stated* that the formation of a hæmatocele after a section for disease of the pelvic organs was quite a common event, and he thought that it occurred more especially after the removal of ovarian cysts.

The time at which the effusion takes place varies within wide limits.

In some cases the patient's progress may be satisfactory for some weeks, when it is suddenly interrupted by the effusion; in other cases it may begin to form at the conclusion of the operation (C. Martin), or after a few days (Tait), or after a few weeks (Duncan), while in one of our own cases the effusion did not occur until three months after the operation.

The blood is poured out into the cellular tissue, which lies at the side of the uterus and in the folds of the broad ligament.

* 'I cannot form an exact estimate of how many cases of these operative hæmatoceles I have seen, but it certainly is not less than fifty, and it is more likely to be seventy or eighty.'

The amount of blood effused varies from a few ounces to pints; in fact, in one night a tumour may be formed by the side of the uterus which will reach from the pelvic brim to the umbilicus. Usually, however, the quantity does not exceed ½ pint, because 'we have a space between the folds of the broad ligament which is not capable of rapid distension to an indefinite extent. The broad ligament, when distended, forms a limited cavity, and we shall then have two processes by which the tendency to excessive hæmorrhage is arrested. The first is the natural tendency on the part of the interstices of the broad ligament to limit the bleeding; and again, the pressure of the broad ligament itself, as a membrane distended and resisting further distension, exercises pressure upon the bleeding-point, and becomes a powerful natural hæmostatic' (Tait).

Pathological Anatomy.

In order to understand the events that may follow on such an effusion, the following description of the anatomy of such a hæmatocele by C. Martin should be well studied: 'The blood is poured into the loose connective tissue, and forms a rounded mass embedded between the two layers of the ligament, which are thus widely separated. The peritoneum joining the layers is put on the stretch, and resists further distension. The effused blood, driven in the direction of least resistance, infiltrates the cellular tissue below the level of the ligament. It burrows downwards till it reaches the pelvic fascia, which limits it below, the lower surface of the hæmatocele corresponding with the upper surface of the fascia. The distension of the broad ligament lifts the peritoneum bodily upwards. The peritoneum lining the pouch of Douglas is raised, partly by the traction upwards of the broad ligament, partly by the blood dissecting beneath it. A tense collection of blood thus comes to be formed beneath the peritoneum, to one side of and behind the uterus, in front of the rectum, and above the vagina. It tends to burrow backwards along the uterosacral ligaments to the tissues around the rectum, embedding the latter in a tight collar of effusion. Similarly, the blood may pass forward under the peritoneum in front of the broad ligament by the side of the bladder and on to the anterior abdominal wall, or it may escape at the outer margin of the ligament into the cellular tissue of the iliac fossa. Its progress is stopped below by the pelvic fascia, internally

by the firm adhesion of the peritoneum to the uterus, and above by the resistance of the broad ligament to further distension.'

Etiology.

Such being the manner in which the effusion forms, we may now inquire into the etiology. The blood comes from the veins of the pampiniform plexus lying between the folds of the broad ligament, or from any other veins in this situation.

In those cases in which the effusion occurs soon after an operation, we may suppose that the veins (which in this situation are often in a varicose condition, especially on the left side) have been pierced by the pedicle needle when one with a sharp point has been used. It may also occur through rupture of the veins at the time of the operation through pulling on the pedicle of the tumour when it is delivered through the abdominal incision. This may easily occur in cases where the nutrition of the vessel's walls is affected, and when phleboliths are present.

In a case presently to be related, it occurred after the sudden arrest of the metrostaxis following an ovariotomy.

Inasmuch as the condition occurs apart from operation during the time of the menstrual flow, it is quite probable that its occurrence after an operation is in some way connected with the artificial arrest of menstruation, brought about by some of the pelvic operations. Christopher Martin's explanation, we think, is the correct one: 'Its origin is an abortive attempt on the part of the nerve-centre governing the process of menstruation to bring about the menstrual flow.' The menstrual centre, as the time for the period approaches, brings about in the vessels of the pelvis a vascular turgescence, and one or more of the turgid damaged vessels of the ligament then gives way, and the blood escaping into the cellular tissue, the hæmatocele is formed.

In two cases in which we have observed the occurrence of hæmatocele lately, it was noted that in each the tube and ovary had not been removed on one side, and it was on that side that the blood was poured out.

Symptoms.

The following case illustrates the onset of symptoms soon after the operation. This case is recorded by Tait after operating on a cystoma of the left ovary weighing 14 pounds:

'There were no abscesses; the pedicle was long and thin,

and the operation was as easy as possible. A metrostaxis appeared about twenty-four hours after the operation, as is usual after such operations, the only peculiarity in this instance being that the loss was very abundant. It suddenly ceased, after being present for about twelve hours, and immediately the patient was in great pain. From having seen the accident under similar circumstances very frequently, I knew at once what had happened. I examined and found, as I suspected, a large hæmatocele of the left broad ligament. The hæmatocele increased slowly in size until a tumour could be felt above the brim of the pelvis, and the patient suffered greatly. I also found that the rectum was completely blocked, as I had seen it often before, by a stricture caused by the diffused blood dissecting round the rectum outside the peritoneum.'

As we have already mentioned, the patient may be progressing favourably, and may be in the second or third week from the time of the operation. Just before the time when the period would have occurred if the operation had not taken place, the patient is seized with a pain which is referred to one side of the womb, and which radiates to the lumbar region and down the backs of the legs. The temperature rises somewhat suddenly, and the pulse becomes quick and small. If the effusion is considerable the patient becomes pale and anæmic, and often quite faint, and complains of vesical and rectal tenesmus and colicky pains. The abdomen is usually only sensitive to deep pressure.

On examination the uterus will be found fixed on one side, occasionally on both. 'In the majority of cases the effusion is not extensive enough to be felt above the brim of the pelvis, but in severe cases it is, and then it forms a rounded and distinctly limited tumour, with a feeling of distinct fluctuation. This upward limitation of the tumour and a distinct vaulting of the upper surface, the effusion of blood round the rectum, and a peculiar concave vaulting of the lower surface of the mass, form the characteristic signs of extraperitoneal effusion of blood' (Tait).

If the effusion is situated on the left side, the rectum may be quite blocked by the effused blood surrounding it and constricting it, the upper limit of the constriction being determined by the point of reflection of the peritoneum from the rectum.

Course and Results.

The blood usually coagulates quickly, and the fluid portion being absorbed, the rest lies in a thick layer on the walls of its cavity. Sometimes, however, the blood remains in great part fluid, and putrefaction soon occurs.

In the majority of cases the patient endures more or less pain for a week, though, if all goes well, a vaginal examination shows that after a few days the parts are not very sensitive when touched. The pulse and temperature, which were at first elevated, begin to fall, and the mass loses the stony feel that effused blood in the broad ligament always has. Absorption occurs at first slowly, then rapidly, and no trace can be found after three or four weeks. In some instances, however, some constriction and induration may remain.

In some cases, however, absorption does not occur, but the mass becomes infected from the rectum, the intestines, or the uterus, and suppuration occurs, and we have to deal with a pelvic abscess.

If the amount of blood poured out be excessive, the blood may force its way between the bladder and uterus, and infiltrate the opposite side, or it may strip off the peritoneum from the anterior abdominal wall as the swelling advances upwards towards the umbilicus. In very exceptional cases it may rupture into the peritoneal cavity, a result which is likely to happen when the posterior wall of the sac is thin, as in a case—not, however, after an operation—recorded by Kuhn, in which just before a menstrual period an effusion took place in one side of the uterus, and the blood forced its way to the other broad ligament and into the peritoneal cavity, intraperitoneal rupture occurring where the posterior layer of the limiting tissue was formed almost entirely of peritoneum only, the anterior wall containing the vessels and the muscular tissue of the broad ligament (Bandl).

In one case which occurred after a section that we had the opportunity of watching, the effusion was noticed some weeks after the operation, and this cleared up, and then a second effusion occurred a month later.

Diagnosis.

In the diagnosis our first duty is to endeavour to differentiate between an effusion and an exudation. The sudden origin,

the anæmia of the patient, the displacement of the womb, the freedom of Douglas's pouch, the absence of rigors and high temperature, are all in favour of an effusion of blood.

An extraperitoneal hæmatocele is only sensitive to pressure at the beginning, or when suppuration has commenced. It is distinctly limited above, while the temperature-chart shows that after the first rise there is a tendency for the temperature to become normal after a few days, if all goes well; while in parametric exudation the chart shows an upward curve, and the same thing may be noted in intraperitoneal hæmatocele.

C. Martin has drawn attention to the tongue when the blood becomes infected. He says: 'In many cases of suppurating hæmatocele the tongue presents a characteristic appearance. It becomes rounded, smooth, dry, glazed, and of a vivid red colour. In fact, it looks exactly like a plum-tomato.'

Cushing has recorded a symptom which may be useful in diagnosing pelvic hæmatocele: 'A symptom sometimes met with in cases of hæmatoma which is not generally known is a discoloration of the urine, evidently from resorption of the colouring matter of the blood, which has been effused. Within a few hours of the violent symptoms attending the hæmorrhage the urine becomes very dark and almost entirely opaque, even in thin layers. It is red by transmitted light, greenish by reflected light and by lamplight. This condition may last for a week or ten days, the colour of the urine becoming gradually lighter. It is not easy to say in what form the colouring matter exists in the urine. The writer observed two cases of the kind, and in one the urine was examined by an expert. It did not give the reaction of hæmin nor of any definite compound. There were no blood corpuscles or albumin in the urine in either case.'*

Prognosis.

The prognosis is good. Tait says: 'In every case in which I have diagnosed the condition the patient has recovered, and in the necropsies which have been made upon cases operated on by me no record of the accident occurs, so that I conclude it is an accident very nearly, if not quite, devoid of mortality.'

When the effusion takes place on the left side and suppuration occurs, the abscess usually bursts into the rectum, and the patient has a desire to go to stool very frequently; whereas before the

* August Martin, 'Diseases of Women'; note by Cushing.

pus is evacuated she has the greatest difficulty with her bowels, and extreme pain at every attempt at an evacuation.

If the effusion is in the right broad ligament the abscess may burst into the vagina, and then the patient quickly recovers.

Treatment.

The treatment of the condition is very simple. The patient should be given a hypodermic injection of morphine if the pain is severe, and an ice-bag may be placed on the abdomen. If there are signs of collapse we may give strychnine and stimulants. The foot of the bed may be raised, and ergotine may be injected into the buttock. Adrenalin may be of use.

If the hæmorrhage is not alarming the patient will have little shock, and it will not be necessary to do anything more than support the patient's strength, taking care that the rectum is not so constricted by a left-sided effusion as to cause obstruction.

In some rare cases, however, the hæmorrhage may be so alarming that an operation may be called for. In the only case among the many that Tait had in his practice that he operated on, he first tapped the hæmatocele from the vagina and drew off a large quantity of tarry blood; but in fourteen or fifteen hours the sac had filled again, and the patient had become exsanguine. He therefore reopened the abdomen, opened the distended cavity of the broad ligament, emptied out the blood, fluid, and clots, sponged it out with vinegar and water, fastened the edges in the aperture to the edges of the parietal wound, and placed in a drainage-tube, and the patient recovered.

In a case recently reported by Duncan occurring after hysterectomy for fibroid of the uterus, he says that the patient was very pale and unhealthy-looking. Fourteen days after the operation she had rather a profuse hæmorrhage from the vagina, and a tumour formed in the left side of the abdomen, reaching up to a level with the umbilicus. The woman was somewhat collapsed. She was etherized. 'I then transfused her with 4 pints of saline fluid, after which I opened the abdomen, cleaned out the blood and clots from between the layers of the left broad ligament, and secured the bleeding vessels by putting on three large clamp forceps. Iodoform gauze was packed round the forceps, and the abdominal incision was closed. The forceps and gauze were removed after forty-eight hours. An indiarubber drainage-

tube was inserted, and the patient made an uninterrupted recovery.'

It will seldom happen that an operation is called for, and unless a secondary rupture takes place into the peritoneal cavity, it is advisable to leave the case alone, trusting to the fact that, as the hæmorrhage is taking place into a closed sac, it will cease sooner or later, and in the meantime, if necessary, transfusion may be resorted to in order to tide the patient over the

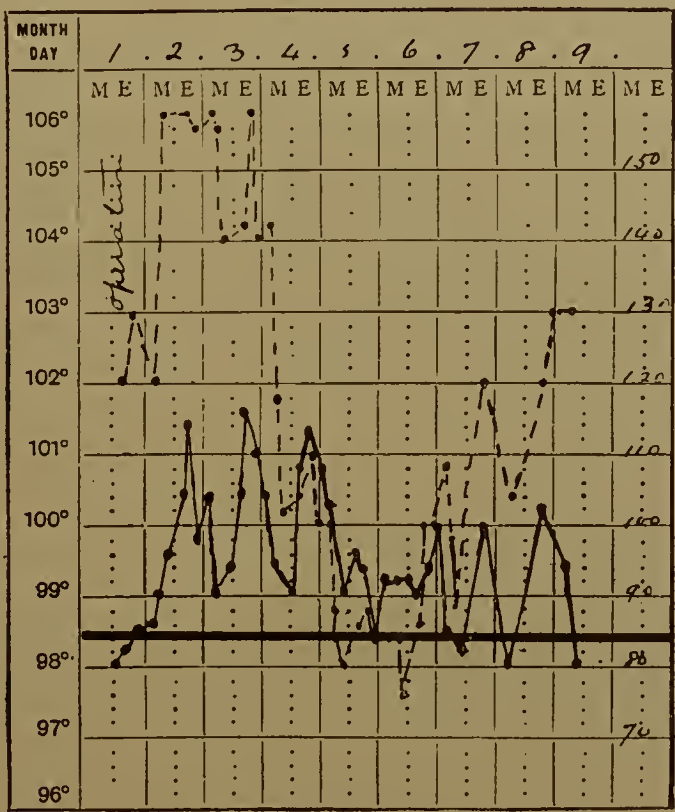

FIG. 130.—Chart of a Case after removing Double Pyosalpinx and the Appendix ; Nephritis ; Uræmia ; Death.

crisis. By the rectum we may give chloride of calcium in 60-grain doses three times a day.

Should the case not clear up, but the patient show signs of sepsis and begin to waste, the tumour may be attacked from the vagina, the clots cleared out, and the resulting cavity wiped or irrigated and stuffed with iodoform gauze.

No greater mistake can be made than to 'explore' an extra-peritoneal hæmatocele with a needle. The result will almost invariably be suppuration, after which the pus may burst through the vagina or the rectum, or it may find its way up to the groin.

The chart (Fig. 121, p. 258) illustrates the rise of temperature that occurs when the effusion is followed by suppuration. The operation had been performed on September 17 for double salpingitis. She made an uneventful recovery, and was allowed to get out of bed on October 10 (twenty-third day). On the 12th she was seized with a severe pain in the right side, and the temperature ran up to 102° F. and the pulse increased to 120. An examination showed a large hæmatocele of the right broad ligament.

The patient remained in bed and the temperature began to fall; but the pulse remained rapid, and after the temperature had reached normal the effusion became infected, the pain increased, and the temperature again began to rise. When examined now the patient complained of great pain. Twelve days after the first symptoms the patient became relieved quite suddenly, as the abscess burst into the vagina.

CHAPTER XLIX

FOREIGN BODIES ACCIDENTALLY LEFT IN THE ABDOMINAL CAVITY

How often this accident has occurred it is impossible to say, for, as Doran remarks, the accident must have been occasionally overlooked in fatal cases where no necropsy was allowed, and in other cases surgeons are loath to publish their experiences on the subject, as the accident is so little to their credit.

Wilson, in 1884, forgot a sponge in the abdominal cavity after performing ovariotomy, and after recording this case he collected thirty cases of foreign bodies left in the abdominal cavity after cœliotomy.

Neugebauer* collected 109 cases of foreign bodies left behind, and Schachner† has collected 155 cases, including in this number the cases collected by Wilson and Neugebauer. We have collected a small number of cases not recorded by these authors, but Schachner's paper will be the groundwork for the present chapter.

The following cases will illustrate the large variety of foreign bodies left behind in the peritoneal cavity. It is not to be supposed that the accident has happened only to men unskilled in operative work; on the contrary, the recorded cases show that many of the most famous gynæcologists have had to admit that this accident has occurred in their practice.

Sponges have been left behind, either because they were not counted at the conclusion of the operation, or because one of the sponges having been divided, the surgeon was deceived in his count. Thus Tait performed a section, using twelve sponges, which were all present after the operation. Without Tait's knowledge the assistant had torn one sponge in half, and one

* *Monats. f. Gynäk. u. Geburts*, 1900, vol. xi., No. 4.

† *Annals of Surgery*, vol. xxxiv., p. 499.

of these halves remained behind. After four hours the sponge was removed by Tait.

The same accident happened to Atlee and Kocker, a sponge being divided by an assistant without their knowledge. These cases ended fatally, and the sponges were recovered at the autopsy.

In Neugebauer's collection of cases there are thirty-one instances of sponges being left behind, while gauze-sponges and napkins were left behind on thirty-three occasions.

Not only may one gauze-sponge be forgotten, but the following case shows that a second one may be left behind.

Severeano records that after an operation for ovarian sarcoma the wound refused to heal; notwithstanding the absence of fever there still remained a stubborn fistula. After laminaria dilatation of the fistulous path, the operator discovered a string in the fistulous opening, and pulled out a gauze compress 130 centimetres long and 30 centimetres broad. Twenty-two days later he again drew out of the same fistula another gauze compress the size of the previous one.

Besides gauze-sponges, swabs of wool have been overlooked and left behind.

Marsh* relates a case of a patient who was explored for gall-stones. Nothing was found. After a few months intermittent pains became frequent. Seventeen months later a distinct swelling was noticed at the lower edge of the liver. The abdomen was opened, and a ball of wool was found surrounded by adhesions. When the swelling was incised a little odourless pus escaped from a sebaceous-looking mass, which was the wool. The cyst was removed in its entirety.

Neugebauer records nineteen cases where artery forceps were left behind, but he does not mention the following case: In a post-mortem examination held in Melbourne on the exhumed body of a patient who had died after ovariotomy, Dr. Glendinning reported that 'after prolonging the incision I found about three quarts of bloody fluid and a sponge, about 2½ inches in diameter, semi-floating near the upper end of the incision. I then felt about with my hand, and got the bulldog forceps outside the peritoneum. They were situated between the muscles and the peritoneum, secured to the bloodvessel to which they had been originally attached.'

* *Lancet*, March 2, 1901.

Kosinski, after performing a section for an ovarian cystoma, left behind two pairs of artery forceps, and the patient met with a most tragic death, as we shall presently relate.

In one case that has been recorded the operator left behind a Richelot clamp. Neugebauer records only three instances where drainage-tubes were left free in the abdominal cavity; we shall, later on, mention three other cases where pieces of a broken glass tube were left.

Kijewski found a fragment of an irrigator in a woman who had died of nephritis that followed two weeks after an abdominal section. The irrigator while being held at a considerable height burst, and a fragment of the glass fell into the abdominal cavity without being observed.

Cushing lost during a section a seal ring. After some years he recovered the same through an incision in the fundus of the vagina. This may be the same case that Clarke* refers to. He says that he was told that a patient was operated on for some abdominal disease, and as she was not relieved she applied to a second surgeon, who examined her *per vaginum*, and felt a foreign body posterior to the uterus; it felt like a seal finger-ring. She related this to her nurse, who said that the surgeon had discovered the loss of the ring immediately after the operation. He searched everywhere, and then had the patient returned to the operation-theatre and reopened, but he found nothing.

The second surgeon now reopened through the vagina and extracted the ring. The patient naïvely offered it to the first operator, but he disclaimed all knowledge of it!

Symptoms, Course, and Results.

The symptoms that will follow the retention of a foreign body will depend upon the **nature** of the body, the **region** in which it is situated, and whether the operation was a **septic** one or not.

If a pair of forceps have been left behind after a clean section, there is a possibility, as several instances prove, that the patient may suffer very little inconvenience for weeks or months afterwards; but sooner or later the foreign body causes a fistulous opening, and is discharged, either into the bladder, by way of the vagina or bowel, or it may ulcerate through the abdominal walls.

Ellison† removed portion of a pair of forceps that were found

* *Progressive Medicine*, vol. ii., 1899   † *Lancet*, February 16, 1901.

protruding through the integument 3 inches below and to the left of the umbilicus. The abdominal operation had been performed eight and a half years previously.

In a case related by Olshausen the patient returned home after an ovariotomy and remained well for nine months. Then abdominal pains set in, and terminated at the end of two weeks with the evacuation of a pair of forceps through the rectum.

The following case* shows the grave results that may follow when a pair of forceps are left behind:

In August, 1894, a woman, aged twenty-nine, had both appendages removed for double pyosalpinx. An abscess developed in a suture track and became fistulous. In December, 1894, left parametritis set in, and an incision was made in the iliac fossa. An abscess developed in the cicatrix of the abdominal incision, and on opening a fæcal fistula developed. Profuse suppuration ensued, and an incision into the lower part of the abscess was made through the vagina, followed by drainage. The patient's health improved for awhile, but urine soon began to pass from the vagina, the abscess having communicated with the bladder. The vesico-vaginal fistula seems to have closed spontaneously, but in March, 1897, urine once more dribbled from the vagina, and one month later a parametric phlegmon developed on the right side, and this was then opened. Not long afterwards an end came to the patient's four years' trouble, for one day she passed at stool a pressure-forceps $4\frac{1}{2}$ inches long, and soon became restored to health.

Neugebauer,† in his summary of the fate of the cases in which forceps were left behind, shows that six died almost immediately after the operation of sepsis, one after a second operation performed some months later for the removal of the foreign body. In three cases the forceps were expelled spontaneously *per anum* —one four years, one nine months, and one ten months after the operation. In one case the forceps worked through into the bladder; in two cases they were discharged through abscesses in the abdominal wall. In one case the artery forceps were found in Douglas's cul-de-sac before closure of the abdominal wound. In two cases the loss of the forceps were noted immediately after

* *Morestin Vratch*, No. 26, 1898; *British Medical Journal*, February 18, 1899.

† Clark, *Progressive Medicine*, June, 1901.

the closure of the wound, and were recovered before the patient was removed from the operation-table.

In four cases a subsequent abdominal section was required for their recovery—one six months, one several months, one two years, and one three and a half months after operation.

When a sponge or a piece of gauze has been left behind, the patient's case is not only more likely to be a fatal one, especially if the case has been a septic one, but if the patient does not die the presence of the gauze will sooner or later give rise to an abscess or a sinus.

Sometimes a piece of gauze may be retained without giving rise to any symptoms. Howard Kelly mentions a case in which after packing the pelvis with gauze strips 'the end of one piece was not brought out, and in consequence the gauze stayed in the abdomen for six weeks, and was discovered and pulled out as the patient was ready to leave the hospital.'

Le Conte* relates the case of a woman who had a section performed for tubercular peritonitis. A sinus afterwards formed, and twelve months after the first section Le Conte introduced a pair of forceps, and a piece of gauze about 5 feet long and 1 yard wide was removed. The large cavity that remained soon filled with fæces, and the entire intestinal contents were discharged from the abdominal wound, none being passed by the rectum.

In some cases the gauze pads ulcerate into the bowels and are discharged by the rectum. Neugebauer found that this occurred in ten cases out of thirty-one. At other times a fæcal fistula forms, and on operation the gauze is removed from the intestine. Thus, Buschbeck records a case where an abdominal section was performed for suspected ruptured tubal pregnancy. Two years later the patient suffered from severe colicky pain in the right side, and the abdominal cicatrix gave way, and liquid fæces were discharged; after a time the fistula was dilated, and a gauze pad came away from the intestine. Stelzner operated and resected 8 inches of the intestine, and the patient recovered.

The fate of the cases in which sponges were left behind in Neugebauer's list of cases is as follows:

In nineteen cases they were discovered at autopsy.

In two cases the sponges were missed before the closure of the abdominal wound and were found, and in three cases the abdominal wound was reopened before the patient left the table.

* *Annals of Surgery*, February, 1901, p. 208.

In three cases the abdomen was reopened in twenty-four hours, and once four days, after the operation. In one case the sponge was discharged over five months later through an abscess in the abdominal wall. In one case the sponge was discharged piecemeal through an abdominal fistula one and a half years after the operation.

In thirty-one cases pieces of gauze were left behind. Death occurred in seven. The gauze was discharged by the rectum in ten cases, the time varying from two days to twelve years after the operation. In four cases a second abdominal section was required for the recovery of the gauze. The remainder were discharged through intestinal fistulæ, and in one instance through the prevesical space. In another case it was recovered by vaginal hysterectomy. In another it was discharged by the vagina, and in two instances, although the gauze was known to be in the abdominal cavity, it was left in the hope that it would discharge spontaneously through suppuration.

Drainage-tubes have been left behind in some cases, but none of these cases appear to have ended fatally.

Nussbaum, after performing a section, inserted a large drainage-tube. The tube disappeared, and was supposed to have slipped out externally. The patient returned home, and two months later, after dancing at a ball, the tube slipped out.

In another case the tube was recovered by abdominal section four days after being left behind. In another case it was found two years after the original operation at an autopsy, while in another case it was discharged by the rectum two weeks after the operation.

Prognosis.

Neugebauer's collection of cases show that fifty-eight patients recovered and forty-two died. Many of these cases died, not because a foreign body had been left behind, but because they were septic cases. If the case is a clean one, the retention of a pair of forceps or of a piece of gauze in the abdomen, while a serious accident, because of the fistulæ and abscesses likely to be formed sooner or later, is not to be regarded as an accident that will lead to an *immediate* fatal result. It is quite remarkable how tolerant the peritoneal cavity is of foreign bodies, and this is well exemplified in Le Conte's case, where a piece of gauze 5 feet long and 1 yard wide was left in the abdomen.

If the sponge be aseptic, it may be gradually removed by

phagocytic action. This is illustrated by a case related by Noble, where, after performing a cœliotomy, he reopened the abdomen after some time and found the remains of a sponge that had been left in the utero-vesical pouch. The leucocytes had almost entirely disintegrated the sponge, very little of it remaining. Noble considered that had the second operation not been performed the entire sponge would have been absorbed.

The effect of a foreign body in the abdominal cavity, as Schachner points out, depends primarily upon its sterility. If it is not of an aseptic nature a general infection ensues. If the foreign body is practically aseptic in its nature, then, as experimental evidence has shown, the tendency is for it to become enveloped in a capsule of fibrous exudate, interspersed with leucocytes, and the isolation is still further carried on by adhesions between the surrounding organs. Thus encapsuled, it may remain quiescent for months or years, or its presence may lead to suppuration, and the foreign body may be discharged through the fistulous track, which may communicate with the surface, the bladder, the bowel, or the vagina.

So long as a foreign body remains in the abdominal cavity it is a menace, for though it may give rise to no symptoms at first, yet it may do so years after, as we see in the instance related by Hefting,* where, after twelve years, a sponge that had been left behind after performing a section was discharged *per anum*.

While the entrance of the foreign body in the bowel may be followed by no serious results, yet several cases show that complete obstruction of the bowel may follow, or a fæcal fistula may form.

A pair of forceps free in the abdominal cavity may, by a sudden movement, be violently driven into a large bloodvessel and cause the death of the patient. This occurred to a patient operated on by Kosinski. The surgeon believed that he had left two hæmostats in the abdominal cavity. He reopened the patient six weeks after the first operation, but did not find these instruments. Some months later the patient was in a railway-carriage, and before arriving in the station she reached up to get some baggage, and at the same moment she felt herself suddenly become faint. On the next morning the patient was very ill, and had passed a vesselful of blood-clot. A radiograph was taken with negative results, but on the following day the abdomen

* *Deutsche Medicinische Zeitung*, March 5, 1897.

was opened. The pouch of Douglas was found covered by inflammatory bands. A second oblique incision was made above Poupart's ligament. A large cavity was opened, in which both hæmostats were discovered lying parallel and just above the pelvic brim. Both forceps had forced an entrance into the left internal iliac artery. The removal of the forceps was attended with a furious hæmorrhage, which the operator endeavoured to control by compressing the aorta. The cavity was tamponed. The patient died upon the table.

Treatment.

Prophylactic.—Since the accident is one that should never occur, it behoves every surgeon to know how many sponges he is about to use before he starts his operation.

'If the surgeon at the close of the operation asks for a count of sponges, and this is made, and an assurance given that all sponges and pads are present, his responsibility on this point ceases, for it is neither prudent nor fair that he should leave his, the most important, part to do duty that justly belongs to the nurse' (Schachner).

In order to help the nurse, the surgeon may adopt the plan practised by Cripps at St. Bartholomew's, where a 'black marble slab is let into the wall, and on this, at the dictation of the operator, the number of sponges and instruments is written down as they are counted. At a private operation this can be done on a sheet of paper, but the precaution should never be neglected. I insist that there should be no sponge of any kind left in the operation-theatre except those counted aloud. I also am particular that no basins, towels, buckets, or slops are removed from the theatre till the sponges and instruments have been recounted after the completion of the operation. . . . The basin at which the sponges are washed should have a grating fixed over the plug-hole at the bottom to guard against the possibility of a sponge escaping through it. This accident, impossible as it might seem, actually occurred at St. Bartholomew's. A thin flat sponge, nearly 5 inches in diameter, was missing on the completion of the operation. Every part of the theatre was searched without avail, nor could the sponge be felt in the abdominal cavity among the intestines. The sponge was afterwards found in the catch-trap leading from the basin.'

In using sponge-cloths it is a good plan to have a piece of tape

attached to the corner of each sponge, and this can be left hanging out of the abdominal wound. Kaltenbach says the omission of this precaution once forced him into the predicament of being compelled for fifteen minutes to search the entire abdomen and pelvis for a missing sponge. It was finally found behind the sigmoid flexure, surrounded on all sides by its smooth mesentery. Hartley records a case, however, where a gauze pad, with clamp attached, was lost in the peritoneal cavity.

In dealing with pus-tubes which have ruptured, we sometimes lay aside a soiled sponge, so that it may not be used again during the operation. When this is done, the sponge should always be placed in a dish, so that it may be counted at the conclusion of the operation, and on no account should it be thrown away before the operation is complete. Again, if during the course of an operation we are short of sponges, the surgeon should never allow any fresh sponges to be taken from his reserve stock without being informed, else considerable doubt may exist at the conclusion of the operation with regard to the number of sponges in use.

Another practice is common, and though we resort to it ourselves occasionally we can only condemn it. We allude to the use of small wool swabs which are called into requisition on the spur of the moment in dealing with the escape of pus. These swabs may easily be overlooked, and, being soft, if once they get out of sight, they would be found only with great difficulty.

Lastly, no sponge should ever be divided during the course of the operation without the surgeon's knowledge, and when closing the abdominal wound, and a flat sponge is left behind to prevent the escape of the intestines, great care must be exercised in removing this sponge, for, unless it is of fine quality, it is not at all an uncommon experience to find that, while dragging the sponge through the half-closed abdominal aperture, a considerable piece is torn off, and this may be easily overlooked and left behind.

Operative.—If we discover that a sponge or a pair of forceps has been left behind, we should at once proceed to open the abdomen, unless the patient is suffering from great shock, when we may postpone the operation for some hours until the patient has rallied. If the case has been a clean one, and the patient is very weak, we need not interfere for two or three days. If the

case is a septic one, we should act as soon as possible, unless the patient is very weak.

It may not be necessary to open the whole length of the wound. Thus, in a case where Olshausen left a sponge behind, he opened the lowest two sutures in the abdominal wound, and removed the sponge with a volsella an hour after the termination of the operation, and the patient recovered.

In one case Spencer Wells left a pair of forceps behind, and he was able to extract it some hours after the first operation, having found it wrapped up in the omentum; and it may here be remarked that the omentum should always be examined when a foreign body has been left in the abdomen, for it appears to have a special aptitude for enclosing foreign bodies.

In another case where Wells left behind a pair of forceps they were extracted from the patient's bladder a month later, but she died.

Thornton read a paper before the Medical Society of London in 1879, and recorded the fact of having left a sponge behind after an ovariotomy, but he claimed that it was the first recorded case where recovery had followed its removal.

Howard Kelly, twenty-eight days after performing cœliotomy, reopened the patient on account of septic symptoms and the presence of a smooth, boggy, moveable mass, which extended from the median line to the left flank. An incision was made over the swelling, and a piece of gauze, weighing 360 grammes, was removed from a cavity apparently completely walled off from the general peritoneal cavity. Much thick, greenish pus was evacuated, and the abscess cavity was sponged and irrigated. A counter incision was made in the left flank, and iodoform gauze placed in the bottom of the cavity and brought out of the lateral opening. The wound was then closed. After the operation the temperature became normal, the wound was irrigated and dressed daily, and the purulent discharges gradually subsided.

Once when assisting Tait at a section the lower end of the glass drainage-tube broke off. An effort was made to find the piece, but without avail. Another tube was inserted, and next day the broken piece of the first tube was removed by an incision through the vagina.

In a case recorded by Malcolm, he discovered on the fourth day that the glass drainage-tube had been fractured. He

removed some sutures, and fished up the lower half of the tube with a pair of forceps, the blades of which were covered with rubber tubing.

In a case recorded by Cripps, he found on withdrawing the glass tube that the lower end was jagged and irregular, and that it was much shorter than the one originally introduced. The broken end of the tube could not be made out by a probe, but some days later it could be clearly made out at the bottom of a sinus which existed. The broken piece was not recovered. Seen six months later, no sinus existed, and 'the glass end of the tube remaining in the abdomen has given no trouble.'

In a case where Holland had removed two very adherent ovaries symptoms of hæmorrhage set in, and the wound was reopened. A little later the bleeding recurred, and the patient was opened again; while later on a sponge was reported to be missing, and the abdomen was opened again, but no sponge was found. The patient recovered.

If a vaginal examination showed the foreign body in Douglas's pouch, we would prefer to make an incision in the posterior fornix rather than to open the abdominal wound; while in any case, if the patient was much collapsed, we would not deem it necessary to open the abdomen to remove a pair of forceps until the patient had rested for some days.

CHAPTER L

FÆCAL FISTULA—SINUS AND SEQUELÆ DUE TO LIGATURES

Fæcal Fistula.

The formation of a fæcal fistula is one of those complications that will make the most charitable-minded patient think ill of her medical attendant, for the escape of fæces prevents a woman in the lower rank of life from attending to her household duties with comfort, while it is loathsome to a refined woman.

When the extraperitoneal treatment of the pedicle began to be abandoned, and ovariotomists ventured to drop the stump back into the peritoneal cavity, fæcal fistulæ were no uncommon sequelæ, because the ligatures were improperly prepared; pelvic abscesses, which burst into the bowel, followed, and fæcal fistulæ appeared later.

Spencer Wells illustrates this by a case operated on by Keith. At the end of six weeks a pelvic abscess formed and pointed a little above Poupart's ligament. Some months afterwards there was a sudden escape of coagulated blood from the rectum, followed by a free discharge of pus from the opening in the groin. Fæcal matter soon made its appearance, and continued to flow from the fistula for some time. This was the only case in which at the time Keith had returned the pedicle with ligatures into the abdomen after ovariotomy.

Wells records a case of Bryant's where the pedicle was dropped back, tied with whip-cord. The ligatures were discharged some months afterwards through an artificial anus at the lower part of the abdominal wound.

Undoubtedly this same cause underlies some of the fæcal fistulæ of the present day; the silk ligatures become contaminated during the course of the operation, an abscess forms around the pedicle, adhesions form and limit it, fæcal extravasation occurs from a neighbouring coil of intestines, and the

abscess finds its way to the surface, and a fæcal fistula is the result. Bland-Sutton remarks that such fæcal fistulæ not uncommonly occur as sequelæ to operations for advanced tubal pregnancy.

Injury to the intestines during the course of the operation is probably the most usual cause for fistulæ at the present time; and this especially applies to the rectum, because while separating adherent tubes or cysts we are frequently compelled to remove a portion of the wall of the bowel. If the peritoneum only is stripped off a fistula may form, but if the muscular coat is injured or removed a fistula is still more liable to result; and this is especially the case if the contents of the tumour are purulent, and have made their way to or near to the lumen of the bowel, or if ulceration has extended from the bowel towards the tumour. After the operation the bowel walls hold until some extra strain, such as a rectal injection, is put on them, and then they give way.

In other cases the pressure exerted by a tumour has caused a local necrosis in the bowel wall; while, on the other hand, the vessels supplying a segment of gut may be occluded during the course of the operation, or the vessels may be blocked later on by emboli.

In some cases the bowel has been injured at the time of the operation, and the opening has been closed, but this reopens later on. This is especially liable to occur when there is malignant infiltration of the walls of the gut.

Fistulæ have resulted from injury to a segment of bowel adhering to the cicatrix whilst performing a section for the second time, or, as in operations for appendicitis, where the colon is adherent and is entered.

When the glass drainage-tube was in common use, perforation of the rectum occurred from the pressure of the tube, and a fistula resulted.

Greig Smith says that on one occasion, in removing a large suppurating, putrid, and universally adherent Fallopian cyst, he had to leave behind a considerable portion of the thick cyst wall in a matted mass of inflammation, sessile on the left iliac vessels and sigmoid flexure. After drainage and daily syringing for more than a month, this came away through the drainage opening as one slough, which filled a 3-ounce bottle. A fæcal fistula resulted, which spontaneously healed.

In a case that Harrison Cripps operated on, the abdominal wound opened two weeks after the operation, and a large gap formed between the edges of the skin. 'This gap was apparently occupied by a coil of intestine covered with granulations, and peristaltic movements could be seen on it. A fistulous opening now appeared in the lower part of this portion of the intestine,* a quantity of fæcal material draining away . . . and it was then discovered that there was another opening further down.' The patient died from exhaustion five months after the original operation.

When a foreign body has been left in the abdominal cavity, its presence excites an ulcerative inflammation, and the body works its way in many instances through the walls of the intestine. Before its entrance into the bowel its presence excites an adhesive inflammation around its position. In some cases after the escape of the body the walls of the cavity, before occupied by the foreign body, now collapse, and nothing further results; in other cases, however, the walls of the cavity do not collapse, fæces escape from the bowel, and ultimately a fæcal fistula is formed by communication with the surface. Johnson† was called to see a case in which a gauze-sponge had been left. 'For the first ten days after the operation the patient did well, then a localized peritonitis developed, and a swelling occurred near the umbilicus, and finally an abscess ruptured there. It was discovered that this abscess connected with the intestine, and a fæcal fistula was the consequence. The woman's health declined so rapidly that it was deemed necessary to repair the fistula. I undertook this, and found an extremely large opening in the small intestine, involving more than half the circumference of the gut. A rapid end-to-end anastomosis was made with the Murphy button, and the abdomen closed, the fistulous tract having been dissected out.' A large gauze pad was found on examination in the rectum.

Very rarely a fæcal fistula arises from the bowel being caught by the sutures closing the abdominal wound. Wells records a case operated on by Lyon, and Doran, in commenting on this case, says: 'Dr. Keith informs me that the perforations were

* We have recently had a similar result: the abdominal wound opened, a coil of intestine was seen at the bottom of the incision, and a fæcal fistula followed some weeks later.

† Schachner, *Annals of Surgery*, October, 1901.

believed to have been made by wounds from the needle used in applying sutures to the abdominal incision. . . . When some the sutures were removed, fæces poured out from the holes in the surface of the intestine.' A fæcal fistula remained for fourteen years at the lower angle of the abdominal cicatrix.

Cases have been recorded where a fæcal fistula resulted from the bowel giving way on the proximal side of an obstruction originating after cœliotomy.

In cases where the abdomen has been opened and drained for tubercular peritonitis, there is a peculiar tendency for a fæcal fistula to form, probably from perforation of a tubercular patch in the intestine (C. Martin).

Clinical Features.—If the bowel has been lacerated during the course of the operation, and a drainage-tube has been inserted, fæcal matter will begin to issue from the tube during the first few days after the operation; often before the fæces come gas is found to be escaping.

On the other hand, if perforation has not actually occurred, the fæces may not escape for days. During this interval the spot where the rupture will occur may become quite shut off from the general peritoneal cavity by adhesions. Then some extra strain is put on the bowel, and the weak spot gives way, and the fæces find their way to the abdominal wound, and are then discharged. In one of our own cases the cæcum gave way after an operation for appendicitis after ½ pint of fluid had been injected into the rectum.

Butler-Smythe* removed in one instance an adherent ovarian cyst; the pelvic portion of the tumour was enucleated, and the capsule fastened to the lower end of the abdominal incision. 'On the eighth day after the operation an enema of 10 ounces of olive oil was ordered. By an unfortunate mistake 1½ pints of soap and water enema was given after the oil, and there being no immediate action of the bowel, this was followed by another injection of soap and water, the result being that the rectum burst, and the fluid came through the drainage-tube, saturating the dressings. As much fæculent fluid as could be got out of the tube was drained off by the syringe, and an enema tube was passed into the rectum to assist in draining the intestine. Fæcal matter and flatus were constantly passed through the drainage-tube, but no bad symptoms appeared, and the patient went on as

* 'Fifty-four Consecutive Ovariotomies,' London, 1897.

if nothing had happened until five days later, when she became maniacal, but ultimately recovered.

In other cases the fæcal fistula is not formed until some weeks or months after the operation. Thus, in the case operated on by Keith and reported by Spencer Wells, the operation took place in October, the patient had pains in the pelvis in December, and an abscess formed, but this did not discharge and form a fistula until the following May.

Once the fæces begin to pass by the artificial anus, the skin becomes excoriated and sore. The colour of the discharges varies according as the colon, ileum, or jejunum is perforated. With the pelvic surgeon the rectum and sigmoid are the seat of the trouble in 90 per cent. of the cases that are met with, and accordingly the discharges from the fistula will consist of brown fæces mixed with pus, and from time to time flatus escapes.

In some cases fæces are discharged for a week or a month, and then nothing but pus will be observed to come from the small puckered opening, while occasionally a silk ligature will be extruded.

The patient at times may complain of painful distension of the lower part of the abdomen, and this is followed by attacks of diarrhœa, the fluid fæces escaping in large quantities from the fistula.

Pathological Anatomy.—In order to understand the difficulties that may attend a radical operation in the presence of a fistula, we give the notes of an autopsy held on one of Wells's cases, where the fistula had existed for eighteen months after an ovariotomy:

'The fistulous opening on the surface of the abdomen was large enough to admit the top of the little finger. Within the abdomen it was so dilated as to admit a middle finger at least. On opening the abdomen we found the edge of the omentum adherent to the wall at the level of the wound, a coil of small intestines sealing the wound above the fistula, which latter was at the lower extremity of the wound. The omentum and subperitoneal tissues were excessively loaded with adipose tissue. A small part of the small intestine, the sigmoid flexure and the rectum, were matted together around the fistula and the left corner of the uterus. Close to the left side of the uterus was a mass, almost spongy and pedunculated, which projected towards the rectum. In the centre of the mass was a large suppurating

cavity which communicated with the fistula and with the rectum by two large openings. The cavity extended for some distance between the uterus and the rectum. It passed towards the right side behind the lower part of the uterus, downwards by the side of the rectum and forwards as far as the femoral ring. No trace of any ligature could be found. The right ovary was healthy. The liver was greatly enlarged, and much altered by fatty degeneration.'

In a case reported by Stone 'in one unfortunate woman who had a fæcal fistula of five years' standing I found, beside the recto-abdominal opening, two loops of ileum discharging into this fistula, also two artificial anastomoses between coils of small intestines and descending colon, one near the splenic flexure, another at the junction of colon and sigmoid.'

Kelly says: 'In the process of formation the fistulous tract is at first surrounded by delicate adhesions binding the viscera together, and walling it off from the peritoneal cavity. Later these adhesions become organized, and form a dense fibrous tube 1 to 2 centimetres ($\frac{2}{5}$ to $\frac{4}{5}$ inch) in diameter and 6 to 10 centimetres ($3\frac{1}{2}$ to 4 inches) long, with a lumen a few millimetres in diameter and lined with granulation tissue, which often presents the appearance of mucous membrane. The tissue of the fistula is frequently so dense as to give the sensation of cartilage when cut with the knife.'

Treatment—Prophylactic.—Mundé, in discussing Stone's case mentioned above, said: 'I have been told that prevention of fistula could be obtained by clean surgery. I think my friend Dr. Noble stated that fistula was always the result of unclean surgery. I think he is right, but still fæcal fistula does occur when the surgeon has been perfectly clean.'*

While contaminated silk ligatures play a rôle in the formation of fistulæ, defective technique in dealing with adhesions is the most important of factors; consequently, one must take every precaution lest in peeling off an adherent tube we remove at the same time a considerable piece of the muscular wall of the bowel. It is much wiser to leave behind a piece of a cyst wall, which can be trimmed down to small dimensions, than run the risk of removing the muscular coat of the bowel.

If, however, we are unfortunate enough to tear the muscular coat, or to open into the bowel, we should close such rents very

* *American Journal of Obstetrics*, vol. xli., 1900.

carefully with silk sutures, and if possible place a flap of peritoneum over the injured surface. In some instances the uterus has been fixed in a retroflexed position, in order that its posterior face might make good the defect.

Should we open the rectum its tissues may be so infiltrated that our sutures will not hold. We must then trust to a gauze drain—which is left in position five days—or to a glass drainage-tube. In a day or so the track of the tube is shut off from the general peritoneal cavity, and our first danger is past.

Should we have injured the large bowel during the course of the operation, or if we fear that the bowel may give way, it is wise to put in a gauze drain; if we do so we should during the first week refrain from administering any enemata or purgatives. Once in removing a double pyosalpinx we opened into the rectum, and a considerable quantity of fluid, left in the bowel from an enema, poured into Douglas's pouch. This was sponged out and the rent closed, and an iodoform gauze drain was packed in over the spot and brought out through the vagina. The patient received no enemata, and the bowels were not allowed to act until the sixth day. The patient never had a bad symptom, and her pulse and temperature were normal.

Treatment—Operative.—If in spite of our efforts fæces are discharged either through the drainage-tube or after we remove the gauze, nothing can be done but to keep the bowel at rest with small injections of morphine, or by giving opium by mouth, and wait for a week or so to let sufficient adhesions form around the track.

Since the large majority of fistulæ, as we have already remarked, are formed in connection with the sigmoid and rectum, experience shows that if left alone they heal spontaneously, unless there is tubercular mischief present.

The reason why fistulæ when connected with the rectum close so readily is because of the fixed position of the gut and its large vascular supply.

All that we need do, then, for some time is to attend to the skin surrounding the artificial opening, keeping it clean and painted with white of egg so that the discharges will not excoriate it. The fistula should be washed out twice daily with Condy's fluid, and from time to time we should explore the track in the hope that we may detach a silk ligature.

When, however, the small intestine is the seat of the fistula

it is much more likely to persist, as the intestinal contents seem to interfere with the healing the nearer the opening in the bowel approaches to the stomach, and in these cases we shall generally be forced to resort to an operation.

The operative treatment adopted will depend on the distance of the bowel from the opening on the surface.

If the bowel has been opened deliberately, and a fistula has been made either at the time of the operation or afterwards to relieve a pseudo-ileus or an ileus, then the operation presents few difficulties, and the fistula may be closed by Greig Smith's operation,* a procedure we have found very useful. Unfortunately, after the opening in the bowel is closed symptoms of intestinal obstruction may follow, and the bowel may have to be opened again. This happened in one of our cases.

As a rule, however, the bowel is connected with the surface by a long fistulous track, so that it will be necessary either (*a*) to dissect out the track, (*b*) to endeavour to get it to close by diverting the fæcal current, or (*c*) to excise the segment of bowel affected.

(*a*) Dissection of the Fistulous Track.—This operation must not be undertaken until six months have elapsed from the time the fistula first formed, for as there is great danger of contaminating the peritoneal cavity, we are subjecting the patient to an unnecessary risk if we operate before we have given the fistula ample time to close.

On the day before we decide to operate the bowels should be thoroughly opened and irrigated, and the sinus should be well curetted and swabbed out with pure peroxide of hydrogen, after which it is firmly packed with gauze.

The preparation of the skin is then commenced and continued until the next morning by placing in position a pack soaked in biniodide of mercury in spirit (1 in 4,000).

A few hours before the operation the gauze may be removed, and the bowel and sinus thoroughly irrigated by a large quantity of fluid, and the track is swabbed with pure peroxide of hydrogen, and the skin again covered with a pack of biniodide in spirit, which is allowed to remain in position until the patient is placed on the table, when the skin is again washed and the track again swabbed with peroxide.

The operation consists in making two oval incisions well away from the fistula through the skin, which is now reflected in

* 'Abdominal Surgery,' vol. ii., p. 728 (fifth edition).

towards the fistula. A sound or some gauze is passed into the track to show the direction that it is taking, and an incision is made about ½ inch away from it so as to open into the peritoneal cavity. The sides of the incision are now held apart, and the spot noted where the track leaves the parietes. That portion of the sinus that runs through the parietes can now be taken out by cutting a wedge of tissue—in the centre of which is the track—out of the whole thickness of the parietal wall. That portion of the sinus that reached from the peritoneum to the skin surface is now set free, and it is surrounded by a silk ligature ; this prevents any of its contents escaping, and it also serves to make traction in the sinus while the intestines are being separated from it in its course to the bowel.

Gauze sponges are packed round the field of operation, and an oval incision is made in the bowel around the spot where the sinus enters, and after excision the opening is closed by layers of sutures.

After the operation we must insert a gauze drain over the site of the sutures in the bowel, and the bowels should be kept bound for at least seven days.

(*b*) Diverting the Fœcal Current.—Stone* has described an operation whose object is to divert the stream of fæces. The posterior fornix is incised as at the outset of a vaginal hysterectomy. Adhesions are separated up to the place where the fistula enters the rectum. A probe introduced through the abdominal opening serves as a guide to locate the fistulous track, which is now opened, and a pair of forceps, carrying a rubber tube, is introduced through the vaginal opening, and serves to guide the tube into the rectum through the fistula, and this tube is secured by sutures.

The tube remains in two weeks, and permits the escape of gases from the rectum and sometimes fæces, while the sinus leading up to the abdominal wall closes up.

(*c*) Excision of the Segment of Bowel Affected.—In some cases it will be advisable to excise the segment of bowel, and use a Murphy's button. This should be done when the tissues will not hold the sutures with any firmness, or when the opening is close to the point of attachment of the mesentery, or when the opening is so large that we cannot sew it without danger of causing a stricture.

* *American Journal of Obstetrics*, June, 1900.

Sinus and Sequelæ due to Ligatures.

The presence of a sinus after a section is always a source of annoyance both to the patient and the surgeon.

It may open above or discharge through the vagina, and it may refuse to close, defying the surgeon's efforts, for the cicatricial tissue of low vitality that forms the walls of such sinūs does not respond to our most energetic remedies, and refuses to throw out granulation to enable the sinus to heal from the bottom.

Etiology.—The chief cause of sinus is the use of unabsorbable ligatures, such as silk, silk-worm gut, or silver.

Under normal circumstances the tissues of the proximal side meet the tissues on the distal side of the ligature, and adhesions form and the ligature becomes buried; the loop is dissected apart by the leucocytes, and if the silk be not too thick the loop disappears. The knot lasts much longer, and may remain for a year or more.

If the ligature has been imperfectly sterilized, or if the tissues on which it is placed are septic, then, as Tait used to say, 'the garotted stump and ligature get the better apparently of the living tissue around them, prevent the tissues absorbing them, cause suppuration, form sinūs which do not heal, but go on discharging till the knot of thread is got rid of, months, it may be years, after the original operation.'

If the whole uterus has been removed the ligatures become at times infected from the vagina.

In cases when the cervix is left after hysterectomy, and the stump has been sewn with silkworm-gut sutures, sinūs are particularly common. Rufus Hall* stated that in forty-six cases of hysterectomy, eleven had post-operative sequelæ due to buried ligatures, but showed no manifestation of an infected ligature earlier than the seventh week following the operation. Some did not have any trouble for three months, others for five, six, and eleven months after the operation. These observations confirm the generally-received opinion that silkworm-gut is a very unsuitable material for **buried** sutures, whether used in the abdominal cavity or in closing the abdominal walls; as a superficial suture material it is perfect.

Another and much rarer cause for sinus is the presence of a

* *American Journal of Obstetrics*, October, 1897.

foreign body—such as a sponge, a piece of gauze, or a pair of forceps—which has been left behind at the time of the operation, and this may give rise to a sinus after months or years.

In cases where the ectocyst of a hydatid cyst has been fixed to the abdominal parietes, a sinus leading down to the contracted cyst will often persist for months. In one of our own cases a sinus existed a year after the operation; in another case the sinus closed immediately a silk suture that had been used in affixing the cyst to the parietes was removed.

In some cases a careful post-mortem examination, or an examination during a second operation, has failed to discover any foreign body, and as Munde* has pointed out, 'it is not easy to account for the formation of a sinus in many of these cases. Certainly, unclean surgery, which some self-confident operators claim to be the cause, cannot always be blamed for the accident.'

Up to recent years the glass drainage-tube was a source of infection to the pelvis, and on withdrawing the tube a sinus was left with a septic ligature in its course.

Cause.—A sinus once formed does not usually close of its own accord, the reason being that, in the majority of cases, a septic ligature occupies some part of its track. Often the mouth of the sinus will become closed with a clump of granulation tissue, covered by a thin red membrane, and then the patient complains of pains, and the temperature rises a few degrees. If the membrane be broken through with a probe the pent-up pus immediately escapes.

In those instances where the sinus does not form immediately after the operation, the patient may progress favourably for a month or more, and then begin to complain of a pain in her left or right side, and suffer with vesical or rectal disturbances, or she may have constantly increasing soreness in the lower part of the abdomen. Should a second operation be performed, a ligature will be found surrounded by adhesions and an area of suppuration. If an operation is not performed then the suppuration may increase, and a pelvic abscess form, which may burrow, and the pus will be discharged through the rectum, the bladder, or abdominal wall, and a sinus will persist until the ligature is discharged. In one of Hegar's cases the distal end of the stump was passed at stool on the sixteenth day.

Tait says: 'If the ligature is placed on the right pedicle it will

* *American Journal of Obstetrics*, November, 1897.

go (as a matter of fact, three of my cases have so travelled) into the bladder, whilst if it be a left broad ligament pedicle to which the ligature has been applied, it will more likely get into the rectum.'

The method by which the ligature becomes enclosed in the broad ligament is shown in the following diagrams of Tait.*

Should the ligatures find their way into the bladder they may set up inflammation. Eastman † says that in one case under his observation twelve ligatures were removed from the bladder, while the thirteenth provided the nucleus of a large calculus.

Thompson, of Rome, performed an ovariotomy, and left the

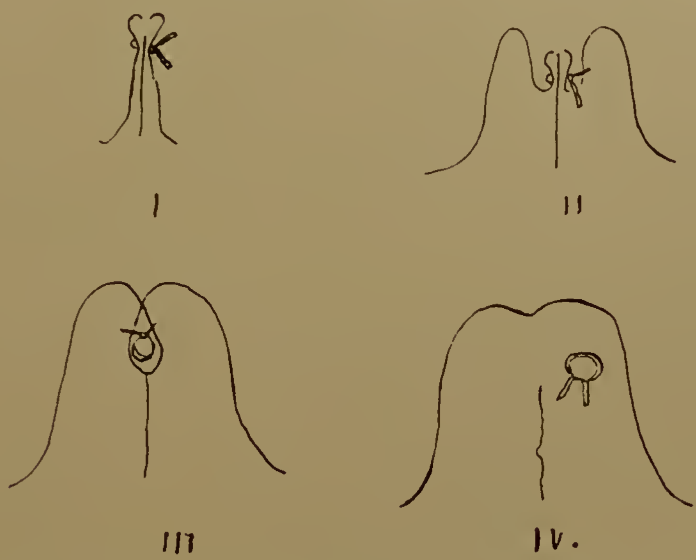

Fig. 131.—Diagrams showing how Intraperitoneal Ligatures may find their way into the Folds of the Broad Ligament (Lawson-Tait).

ligatures on the pedicle hanging outside the abdominal wall. After several weeks, as these did not separate, he cut them short, and let the attached ends drop into the abdominal cavity. After some months had elapsed the patient sought advice for a throbbing pain in the lower part of the abdomen, and complained of frequent and painful micturition. Later on she had pain and fever, but got relief after voiding about 8 ounces of urine loaded with pus and blood, and for several days a large quantity of pus was passed with the urine. A little later the pain in the abdomen returned, and she was admitted into hospital under Pandolfi, who, on examination, found the bladder much dis-

* Tait, *Lancet*, May 16, 1896.

† *American Journal of Obstetrics*, vol. ii., p. 663, 1899.

tended, the fundus reaching to the umbilicus. Immediate relief was necessary, but the catheter could not be passed, the urethra being blocked by a hard, resisting body, and Pandolfi removed a mass which upon examination proved to be a number of ligatures (encrusted by the urinary salts), which had entered the bladder when the abscess had burst through its walls.*

Savor relates a case where a post-mortem was held on a woman who had had Cæsarean section performed on her several years before. A calculus was found in the bladder surrounding a silk suture, and there was a utero-vesical fistula, the silk having worked its way from the uterus into the bladder.

In other cases we have a utero-abdominal sinus formed, the fistulous track communicating with the skin and the uterus.

This has been observed after Cæsarean section, after Porro's operation (when the stump is suspended in the abdominal wound), after enucleating myomatous tumours, and after operations in which malignant disease has been discovered and the uterus has not been removed; a fistulous track then forms, as a result of perforation from the malignant uterus.

In some cases, when there has been extensive suppuration of the abdominal wound, a fistulous track may extend into the uterus.

Werder† has reported a case where an abdominal tumour was noted and an operation performed for its removal. The tumour was attached to the uterus by a broad thick pedicle. After ligature of the uterine stump, it was brought up into the abdominal wound and sutured. The patient made a moderately good recovery, but at the time of her discharge from the hospital there was still a small abdominal fistula leading into the uterine cavity. The menstrual bleeding occurred both in the natural way and through the fistulous track. Later the patient became pregnant and went to complete term, and bore a living child, after which the fistulous tract closed spontaneously, and the patient made a perfect recovery.

Kelly performed Cæsarean section on a septic case. 'After a few days the vault of the vagina became emphysematous, crackling on touch, and the entire cervix sloughed away; subsequently the uterus became emphysematous, and the lower

* Thompson, *Lancet*, vol. ii., p. 1089, 1885.

† *American Journal of Obstetrics*, 1894; quoted by Clark in *Progressive Medicine*, June, 1891.

angle of the abdominal wound formed an abdomino-utero-vaginal fistula, which persisted into the next pregnancy.'

Treatment—Prophylactic.—Haegler* urges the importance of incorporating with ligatures some antiseptic substance which will prevent the development of late abscesses, which he considers are frequently due to infection from the ligatures. He noted that if a stitch ligature were drawn through the fingers of the operating surgeon it would frequently be found to be infected. If, however, the ligature had been prepared in sublimate, though it may have the germs off the operator's hands on its surface, yet the sublimate either destroyed the germs or prevented their growth.

We have from the outset always adopted this plan, and as we used thick floss silk in our first 100 sections, and frequently used the drainage-tube, we nevertheless only had four cases where sinus developed, two being cases of pyosalpinx and two cases of ruptured tubal pregnancy, and in all four the glass drainage-tube was used.

Since silk ligatures are so often the cause of sinus, many operators have abandoned this material for catgut and wallaby tendon. Thus, Olshausen uses only catgut in his abdominal operations, and says that while patients with fistulæ used to continuously return to him after he had operated on them, now only the patients of other men come to him since he has begun to use catgut.

Year by year catgut has grown in favour, and we know several operators who use now no other material. One of our colleagues always uses wallaby tendon, and never uses silk now. There is, however, not an unfounded distrust of catgut when we have to apply it to the uterine arteries, for while secondary hæmorrhage is not likely to occur from a tortuous vessel like the ovarian artery if the ligature has been properly applied, the same cannot be said of the uterine artery, which, being short, feels the full force of the pressure of the iliac stream; and as the patency of the artery at times becomes re-established, secondary hæmorrhage is liable to occur if the ligature has been absorbed.

For these reasons it seems certain that silk ligatures will still continue to be used in pelvic surgery for the large bloodvessels, and consequently sinus will inevitably occur from time to time.

Tait used to realize this, and he has said: 'I have, however,

* *Centralbl. f. Chir.*, No. 5, 1899.

been haunted ever since by the clear thin line of parchment to which Keith reduced his pedicles, and I have looked at my own, often regretting the dead lump of wet and decomposable tissue I had to leave girt by a dead and decomposed ligature.' It was for this reason that in the latter years of his practice he tried to abandon the ligature and 'cook' his pedicles by electricity. This method has now been brought to considerable perfection by Skene with his electro-hæmostatic forceps, an instrument which has a great future before it; while the instruments of Doyen, Tuffier, and Thumin, by exerting an enormous pressure upon the vessels, have proved a successful substitute for ligatures in competent hands.

Treatment—Operative.—Once a sinus is established we may try curettage and irrigation, in the hope that we may get it to heal; but usually our efforts will be futile until we have displaced the offending ligature.

In three cases with which we have had to deal, we have given the patient an anæsthetic, and made an incision through the skin so as to give more room for manipulation. Then after curetting the sides, the sinus was dilated with Hegar's dilators, and a pair of urethral forceps inserted and carried down, carefully nipping at the sides and bottom in the endeavour to catch or detach the ligature. In each case this succeeded, the ligature being withdrawn, and the sinus closed in a few days, although in one case it had existed for eighteen months.

In some cases, however, the sinus leads down to the sutures, inserted in the uterus after a Cæsarean section or after a hysteropexy. In these cases a crochet-needle will often prove to be a handy instrument with which to fish out the offending ligature. If a fistulous tract connects the cavity of the uterus with the skin surface the wound should be dilated and curetted, then the sinus should be curetted and disinfected, and closed by a plastic operation from above.

In some cases the sinus will not close. The difficulties that then beset the surgeon are well described by Mundé. He says: 'I have treated such sinuses by repeated curetting; steady packing with gauze; cauterization with solid nitrate of silver; pure carbolic acid; 25 per cent. solution of carbolic acid in alcohol; the actual cautery; balsam of Peru, without and with castor oil; by freely enlarging the opening, which is at times risky, as the peritoneal cavity may be accidentally opened; by

draining through into the vagina if the sinus extended deep down into the pelvis; and gradually withdrawing the drainage-tube or gauze downwards as the upper portion of the sinus closed. All these methods have been employed by me again and again, and all have now and then failed. Three times the adherent bladder was accidentally injured while drawing the rubber drainage-tube into the vagina; with a permanent catheter in the bladder, and frequent irrigation of sinus and bladder, the rent soon closed. But I am still far from satisfied with the means at our disposal, either to prevent the formation of such sinuses or to effect their rapid and certain closure.'

Harrison Cripps, in treating one of his cases when the sinus remained for six months after a double ovariotomy, first made a plug by softening a strip of gutta-percha in boiling water, and then rolling it out between two smooth surfaces until a solid cylinder was obtained about the thickness of a No. 1 or No. 2 catheter. One end of this was flattened, and the other made conical. This dilator was introduced into the sinus, and kept in position by strapping.

'When the outlet was sufficiently dilated the long narrow cannula of a fine aspirator, not more than $\frac{1}{16}$-inch bore, is passed right down to the bottom of the sinus, often a distance of 3 inches or 4 inches. An indiarubber tube fixed to the other end of the cannula is carried up to a basin of water with a fall of 7 feet or 8 feet. Then siphon action being started, a jet of water is thus propelled into the bottom of the sinus, the ligature being washed out with the regurgitant stream.'

In some very intractable cases* the X rays have proved of service, the sinus closing after the patient has been submitted to the action of the rays. We have tried six applications of the rays to a fistula left after operating on an abdominal hydatid, but there was no effect; we therefore proceeded to dissect out the sinus. It was first curetted, then swabbed with peroxide of hydrogen; after this it was firmly packed with gauze. A large spindle-shaped incision was made in the skin around the sinus, and the dissection continued until the sinus packed with the gauze was approached. It was then discovered in this and in a subsequent case that the true wall of the sinus was only about $\frac{1}{8}$ inch thick, and it is quite distinct from the surrounding tissue;

* Berry Hart, 'The Curative Effect of the X Rays in Callous Sinuses of the Abdominal Wall' (*British Medical Journal*, May 31, 1902).

so that if the dissection be carried on in such a way that this true wall is closely hugged, then the sinus can be easily dissected out. As the distal extremity is reached the sinus wall becomes so thin that a little traction allows the dissected-out tube to be torn away.

The cavity left is then tightly packed with iodoform gauze, and soon closes.

CHAPTER LI

CUTANEOUS ERUPTIONS—SCARLET FEVER

Cutaneous Eruptions.

Cutaneous rashes may appear after any abdominal operation, and they have been observed, according to Christopher Martin, with equal frequency after ovariotomy, hysterectomy, nephrectomy, and exploratory incisions.

Martin classifies these rashes under four types:

1. Typical urticaria: raised wheals, with white crests and red bases.

2. Small red raised discrete papules, the size of mustard seeds, with a pale pink field between.

3. Irregular dusky red blotches, not unlike those of measles.

4. A uniform vivid scarlet blush resembling that of scarlatina.

While of little importance in themselves, these rashes may cause some anxiety until we have differentiated them from scarlet fever. Butler-Smyth records a case that illustrates this. He operated on a young woman, aged twenty-eight, and removed a small ovarian tumour. All went well up to the seventh day, when the stitches were removed; the pulse and temperature were then normal. Next day, 'when I arrived at the house, I found the patient in a state of great excitement owing to the nurse, in her fright, having said something about scarlatina. Her face was flushed, and her neck and shoulders and body were covered with a bright red rash. She complained of swelling and soreness of the throat, and of burning itching of the skin. Her temperature was over 102° F., and her pulse 130.' Smyth called the rash 'urticaria diffusa vel febrilis.'

Tait wrote the following commentary on Butler-Smyth's case: 'Mr. Butler-Smyth's communication is interesting, and confirms an experience which has been to me quite a common one. After

almost all kinds of abdominal sections acute attacks of urticaria occur in at least 6 or 7 per cent. of cases. It seems sometimes to come in outbreaks, for I have quite lately had the appearance he describes come in over eight or nine cases, one after the other, within two or three weeks, and this is by no means the only incident of the kind which I have witnessed. The symptoms are occasionally somewhat severe, but they never give any reasons for anxiety, and the administration of a saline purgative generally causes them to disappear.'

August Martin, in commenting on Tait's communication, says that this has certainly not been his experience in 2,000 cases of laparotomy; but he says that he has seen troublesome eczema come out after double ovariotomy.

Etiology.—In seeking for a cause for these rashes we shall generally find that they occur during some digestive disturbance. There is nothing to show that opening into the peritoneal cavity has anything to do with their causation. The most severe case of urticaria that we have seen occurred after performing an Alexander's operation, when the peritoneal cavity was not entered. That some of the rashes are due to irritation of the uterine nerves is very clearly shown, when we remember Hebra's case, where the mere introduction of a sound into the uterus caused urticaria fifteen times in succession. The troublesome pruritus and the eczema that August Martin says he has seen after double ovariotomy are no doubt due to the artificial menopause produced.

Beside a reflex nervous origin, these rashes are due in some cases to the use of boracic acid and iodoform as dusting-powders, these drugs producing erythema and urticaria; while the frequent administration of turpentine and quinine in large quantities in rectal enemata may also be followed by similar rashes. In a case where we had performed cholecystotomy the nurse next day gave the patient an ounce of brandy in some water by the bowel. A short time after we visited the patient, and found her face scarlet, the lower limit of the colour being sharply defined, and ending half-way down the sides of her neck. On the extensor surface of both arms large red patches an inch in diameter were to be seen at the same time; these were not raised up like urticaria wheals. Half an hour afterwards the colour had disappeared from the face and neck. A month later we opened the patient's liver and drained it, as she had a sup-

purating hydatid cyst. The pus may have been present at the first operation.

In other cases, after operating on abdominal hydatids, a well-marked urticaria may appear if some of the fluid has escaped into the peritoneal cavity.

As is well known, morphia may in some patients produce a patchy erythema, bright pink in colour, and this may affect the face.

Christopher Martin has made the observation that he has seen a skin eruption attack section cases consecutively occupying the same bed in a hospital; he does not suggest that it was due to scabies.

Septicæmia is undoubtedly the cause of some of the skin eruptions met with after cœliotomy. Thus in Wells's forty-first case he notes that a copious miliary rash appeared, and a day or two later the edges of the wound sloughed. In his seventy-eighth case, which resulted in death from septicæmia on the eighth day, he notes that on the seventh day the pulse was 140, and there were mulberry petechiæ on the chest and buttocks.

In his one hundred and third case, which also resulted in death from septicæmia, he notes that the pulse was 130, the tongue very raw, the skin dry, and a free fœtid discharge was coming from the wound. The patient complained very much of urticaria, with which the body was covered, and the urticaria was so troublesome as to prevent sleeping.

In Walne's second case of ovariotomy (performed in 1843) he notes on the seventh day 'that a miliary eruption appeared yesterday on some parts of the skin, and to-day was very general'; a few days later the patient developed thrombo-phlebitis.

In some women who suffer with ovarian disorders there will be noticed a brown pigmentation on the face, which extends over the whole forehead as high as the level of the hairy scalp. This pigmentation often appears to become much intensified for the first three or four days after a section, causing the patient to look more ill than she really is. When, however, she begins to pick up her strength, this chloasma uterinum (Hebra) disappears, and the alteration in the tint* of the patient's skin causes her to look surprisingly well when convalescent.

* Patients suffering from ruptured ectopic pregnancy often have a yellow tinge on the skin, which disappears after the operation when the blood-clot is washed out of the peritoneal cavity.

Treatment.—There is nothing special to be noticed about the treatment of these eruptions. We always give some calomel, and this is followed by a saline purgative, while we administer carbonate of bismuth and bicarbonate of soda in large doses by the mouth. If the patient is a rheumatic subject, the salicylate of bismuth acts well. Vichy water is given freely.

In some cases no improvement follows, and then we must be careful to remove all traces of iodoform and boracic acid from the edges of the wound and dressings, and refrain from administering turpentine and quinine, lest these drugs be the exciting causes.

As urticaria is sometimes very troublesome, from the excessive itching that it causes, a lotion such as lotio zinci oxidi, or one of subacetate of lead (5 minims to 1 ounce of water) may be applied, or the parts may be dusted with a dusting-powder composed of oxide of zinc, starch, and calomel.

Scarlet Fever.

Scarlet fever occasionally attacks a patient after cœliotomy. In some cases the patient is infected by the surgeon, while in other cases the patient is operated on during the incubation of the fever, there being no specific infection by the wound. In other cases the patient develops the fever some weeks after the operation, being accidentally infected from some outside source.

The following are instances of this complication: Tait records that 'many years ago a young domestic servant was sent to me from a mansion in Cornwall with an ovarian tumour, and was sent most improperly without an instruction from her mistress that the children to whom she was acting as nurse had just recovered from scarlet fever. Five days after the operation I discovered that she was desquamating, and then unearthed a clear history. By the time the discovery was made I had performed eleven more abdominal sections, and had carried the infection to every one of them. . . . Three of the nurses were also infected, but fortunately all the fifteen cases recovered.'

Professor Sippel, of Frankfort, reports a case of ovariotomy in a woman aged twenty-two. Four days later the pulse and temperature were high, yet there were none of the evidences of the more dangerous sequelæ of ovariotomy. On the fifth day the characteristic rash of scarlet fever appeared, and the fauces were inflamed. The temperature was 102·1° F., and the pulse 124.

There were no renal complications. The abdominal wound healed perfectly. Sippel maintains that this was not a case of specific infection by the wound, but by way of the tonsils and throat.

When scarlet fever does attack a patient after ovariotomy or after other surgical operations, the attack is usually characterized by its mildness, the patients being affected simply because they do not possess sufficient power to prevail against a dose of the contagion, which would have no effect on them when in good health.

There are, unfortunately, exceptions to this rule. This is illustrated by the following case from our own practice:

The patient, a girl aged seven years, was operated on for a large hydatid cyst extending from the lower border of the right side of the liver almost to the pubes. The cyst wall was sewn to the aponeurosis of the external oblique, and the cyst washed out, dried, and packed with iodoform gauze. The child did well until the ninth day, when the temperature began to rise. The urine at this time was passed in good quantity, and was quite normal. On the thirteenth day the gauze was removed, and the cyst was well irrigated. At this time the temperature was 103·8° F., and the child had a most extreme coryza; the fluid simply ran in a stream from her nose. On the fourteenth day a scarlet fever-like rash appeared on the chest and arms, and the tongue became red and exhibited all the characteristics of a typical scarlet-fever tongue. On the day that the rash appeared a child in a neighbouring bed developed scarlet fever, and the infection was traced to his home. Several other children in the same ward developed scarlet fever later on. About the sixteenth day the temperature fell to 100° F., and the child became very drowsy. The coryza was, during all this time, very intense, and the glands in the neck had become enlarged.

Thinking that some iodoform might still have remained in the cyst, the nurse was ordered to irrigate the cyst with thin starch-water night and morning. The urine now showed traces of albumin, but no iodoform could be detected. The temperature fell on the twenty-first day to 99·2° F. and very little urine was passed, and it contained a large amount of albumin. From this time until the twenty-eighth day—the time of the death of the child—the pulse ranged from 112 to 136, while the temperature was normal or subnormal. The amount of urine passed daily was only a few ounces, and this was loaded with albumin.

The child all this time remained drowsy, and died in her sleep on the twenty-eighth day after the operation.*

We shall have to diagnose scarlet fever from the surgical rashes that not unfrequently arise after cœliotomy. In cases of erythema due to the absorption of turpentine or other drugs, we may be in doubt for some days, for we may get inflamed fauces, and an apparent reaction with nitric acid when the urine is tested. The characteristic tongue, however, is not present in these cases of absorption of drugs, and the temperature is not usually raised, though we may get a branny desquamation in the subsidence of the rash if the erythema has been marked.

Treatment.—The patients should be at once isolated, and the urine should be constantly tested, while the usual treatment for scarlet fever is pursued, such as an exclusive milk diet, with no meat or soup.

* If the capsule of the kidney had been incised in this case it might have done good.

CHAPTER LII

TETANUS—PAROTITIS—INSANITY—IODOFORM-POISONING —GLYCOSURIA AND DIABETIC COMA

Tetanus.

ALTHOUGH tetanus is by no means an uncommon disease,* yet it occurs but rarely now after cœliotomy; this happy result is without doubt due to disinfection.

Olshausen was able to collect, twenty years ago, forty-nine cases of tetanus in the practice of twenty-three operators, and his opinion was that tetanus occurred with comparative frequency after ovariotomy.

Phillips, in 1892, communicated to the Royal Medical and Chirurgical Society of London the results of eighty-one inquiries (addressed to various university professors in Europe), and of sixty-seven in the British Isles, and he was able to furnish complete details of sixty-four cases of tetanus occurring after ovariotomy. Doran, in discussing this paper, said he had assisted at 1,287 abdominal sections, and had only twice encountered tetanus during the after-treatment.

In the early days of ovariotomy the extraperitoneal method of treating the pedicle was the supposed cause of the trouble : but it was not until 1884, when Nicolaier discovered the specific bacillus, that the fact noted by Olshausen—*i.e.*, that nine of the operators whose cases Olshausen had collected had had several cases of tetanus in a short space of time—was adequately explained.

Thus Kaltenbach's two cases occurred among his first five operations, Schroeder's among his first six, while Stilling had seven cases among twenty-nine ovariotomies.

* In England, between 1875 and 1892, there were 2,969 deaths from traumatic tetanus. In 1898, in Greater New York, there were seventy-three deaths from tetanus.

In examining Spencer Wells's notes, we find that he operated on a case of ovarian cyst on October 6; on October 21 (fifteen days after) signs of tetanus showed themselves. He operated on two other cases on October 11 and 12, the first one dying of peritonitis, and the second recovered. He then operated on a case on October 28, and she developed tetanus seven days later, and he notes that although he had not seen a case of tetanus for ten years, 'a third case occurred in my own practice directly after these two.'

The source of the infection may be the hands of the operator or of his nurse, or it may come from his instruments or ligatures.

Lockwood, in discussing Phillips's paper, said that tetanus was an infectious disease, that the poison could be carried by dust, and this first rendered the cases intelligible in which it was stated that draughts appeared to act as a cause.

Koch recently reported a case of a patient, aged forty-two years, who was attacked with tetanus six days after myomectomy, and died two days later. On the stump was found a knot of catgut, and fragments of this induced tetanus in two mice. The catgut had been sterilized by boiling, and kept in oil of juniper. Knowing the immense resisting power of the spores of tetanus, it is evident that such a preparation would be quite inadequate.

Symptoms.—Dorsett* has quite recently reported two cases of tetanus following abdominal section, due to infected ligatures. The first case will serve to illustrate the symptoms met with in this terrible complication.

In the first case ventrofixation was performed on May 3. 'The patient suffered from no appreciable shock, and did well until May 7, when she complained of some rigidity about the lower jaw when she would attempt to take nourishment. Later in the day there appeared a good deal of rigidity of the masseter muscle, and the case became clearly one of tetanus. At 2 o'clock on May 8, 10 c.c. of antitetanic serum were injected subcutaneously, and 8 grains of chloral hydrate were given by the mouth, and repeated every hour until some sleep was produced. Later in the forenoon she complained of some discomfort between the shoulders, when upon examination a bright red spot about the size of the palm of the hand was seen. This blush had an

* *American Journal of Obstetrics*, November, 1902.

abrupt margin, and in the centre were two abrasions. which were supposed to be due to scratches inflicted by the finger-nails of the patient's own fingers. At 12 o'clock noon 10 c.c. of antitoxin were given. Marked convulsions came on, nourishment by the mouth became impossible, and rectal nutritive injections had to be resorted to. At 4 p.m. on the same day 10 c.c. of cerebro-spinal fluid were withdrawn, and 10 c.c. of antitetanic serum were injected into the spinal canal. Chloral to the extent of 30 grains per dose every three hours was given by the rectum, but produced little effect upon the convulsions, which increased in severity and frequency until from thirty to seventy occurred per hour. The body was bathed with perspiration, and throughout the entire illness the temperature did not rise above 100° F. On May 10 morphia sulphate in $\frac{1}{4}$-grain doses was combined with chloral to produce sleep and to quiet the nervous system. Later in the day it was decided to transfuse her with normal salt solution, and a vein was opened for this purpose; but while in the act of throwing the salt solution into the vein a violent convulsion came on, which ended the scene, the patient dying on the third day after the disease was recognised.

'During the entire treatment there were given 500 grains of chloral by mouth and rectum, frequent hypodermic injections of morphine, and 80 c.c. of antitoxin. None of these remedies had the least effect beyond the occasional hypnotic effect produced by the chloral and morphine.'

In the second case ventrofixation of the uterus was performed on May 26. On June 1 the patient complained of a soreness about the angles of the jaw, and she died of tetanus on June 5. The same treatment was adopted as in the former case.

A thorough investigation of the suture material proved that the infection had originated from the kangaroo tendon employed in fixing the uterus to the abdominal wall.

Aspell* recently reported a case following hysterectomy. The operation was performed by the aid of an angiotribe. The patient was free from pain after the operation, with a temperature varying from 99° to 100° F. till the tenth day. The discharges from the bowels from the second day after the operation daily till her death were foul, greenish-brown in colour, and of the consistence of tar.

* *American Journal of Obstetrics*, December, 1900.

On the morning of the tenth day the nurse noticed a slight twitch of the muscles of the face, and flexion of the left arm. It was over in a few seconds.

The surgeon saw the case an hour after the spasm, and found a slight rigidity of the jaws; 40 c.c. of tetanus antitoxin were injected, and 20 c.c. at two hours intervals up to the following afternoon, when the patient died in a spasm. *One of the nurses assisting at the operation had a patient recovering from tetanus under her care in the ward two floors below the operation room!*

Mallett during the discussion on this case recorded the case of a woman, aged twenty-four, who developed tetanus six days after removal of the appendages. She also died.

Diagnosis.—Since strychnine is so largely employed in the after-treatment of section cases, we not rarely see instances of slight strychnine-poisoning; the spasms in these cases are more sudden and more rapid in sequence, and affect the whole frame, frequently coming on during the first twenty-four hours after the operation. Between the convulsive seizures there is complete relaxation of the muscles, and trismus is often absent. Lastly, strychnine may be found in the urine.

Prognosis and Treatment.—As in animals, so in human beings, the shorter the period intervening between the infection and the outbreak of the disease, the more severe is the disease and the worse the prognosis.

With regard to **prophylaxis,** we must remember that the spores of tetanus are exceedingly difficult to destroy, and resist heating for an hour at 80° C., but are killed by exposure to steam for five minutes at 100° C. They resist the action of 5 per cent. carbolic acid, and do not succumb for fifteen hours, while they resist bichloride of mercury (1 in 1,000) for three hours.

No nurse or assistant who has been in attendance on a case of tetanus should be allowed to assist at a section; one cannot doubt that the case recorded by Aspell was due to the nurse who had been in recent attendance on a tetanus case.

If a case of tetanus appears in a surgeon's practice he should boil all his instruments in a solution of microcidine (4 in 1,000) for one hour.

In the active treatment of this very fatal complication we should have recourse to the tetanus antitoxin, for it is stated

that under this treatment the mortality has been reduced from 90 to 40 per cent. (Moschcowitz).

The indications for treatment are briefly stated by Moschcowitz as follows:

1. To destroy the bacteria at the seat of infection, and thereby prevent a further production of toxins.

2. To eliminate from the body the toxins already absorbed from the primary lesion.

3. To neutralize and render innocuous the poison already absorbed.

4. To immunize the body after local infection has taken place.

5. To overcome the symptoms induced by the action of the toxins.

The difficulty that meets us at the outset is that the tetanus germ has been introduced at the time of the operation; it will therefore be impossible, after a section, to attempt to destroy the bacteria at the seat of infection, as this may be the pedicle in the peritoneal cavity, or it may be the abdominal wound. The importance, however, of this first measure can be appreciated when we remember that the experiments of Kitasato, Rosenbach, and others show us that the bacillus of tetanus remains at the seat of inoculation, and there manufactures the toxin which is absorbed. To extirpate this laboratory is therefore most essential, but impossible in abdominal surgery. We must therefore rely on the antitoxin.

Rambaud recently reported a case of tetanus after cœliotomy for uterine myoma. The incubation period was ten days. Soon after the symptoms appeared the antitoxin was injected. The amount injected was 750 c.c. subcutaneously, 50 c.c. intravenously, and 6 c.c. (strong) intracerebrally. The patient recovered, but ten days after the disappearance of all tetanus symptoms she expired. No autopsy was held, but tetanus bacilli were found in the laparotomy wound.

Whether we use the serum or not we should not neglect other recognised therapeutic measures. Sir George Humphry was wont to remark that the sheet-anchor of the treatment of tetanus was food, and when the patients could not swallow they died.

Parotitis.

Parotitis may follow any injury or disease, but it is ten times more common after injuries and operations on the pelvic organs than after diseases in any other parts of the body.

Stephen Paget* collected 101 cases of parotitis which followed operations, injuries, and diseases of the abdominal organs, and out of this number 50 cases followed lesions of the generative organs, and of these cases 27 were cases of parotitis following ovariotomy or oöphorectomy.

In seeking for some explanation of this 'concatenation of diseases,' as Graves was wont to call this class of morbid phenomena, we should not forget that distant organs may exhibit evident sympathy during health as well as during disease. The most striking instance is the metastasis that occurs in the male when affected with epidemic mumps, the testicle being involved secondarily. Much less commonly in the female the breasts are affected, and sometimes we have catarrh of the vagina and vulva, while Boutellier and Meynet have observed in some cases inflammatory swelling of the ovaries. In some instances the pelvic organs are affected first, and the parotitis sets in later.

In the camel the salivary organs are enlarged during the breeding season, and in various animals the thyroid and the odoriferous glands, as Darwin has pointed out, become enlarged during the same season. The thyroid in women enlarges after coitus and during menstruation, and we have seen recurrent attacks of mastitis in the left breast of a woman—suffering with left-sided salpingitis—during the menstrual periods.

After coitus and after operations on the ovaries the nasal mucous membrane may swell and become inflamed, while pain at the menstrual period may be relieved in some cases by painting the turbinated bones with cocaine.

These instances will be sufficient to illustrate the now well-recognised fact that two organs situated at a distance in the body and having apparently no relation or connection one with the other may suddenly develop a morbid condition during the time that one of the organs is physiologically or pathologically affected. This sympathetic relation has been put forward to explain the instances of parotitis that we are dealing with.

* *Lancet*, vol. i., p. 314, 1887; vol. i., p. 732, 1886.

Symptoms.—When parotitis occurs after a section it may be an isolated event, unaccompanied by any other inflammation, or, on the other hand, the patient may be suffering from septicæmia.

The parotitis may set in immediately after the operation, or it may occur as late as the thirty-sixth day, as reported by Foreman,* after a case of Cæsarean section.

Möricke, who was one of the first to draw attention to this complication, observed it several times after ovariotomy, when it occurred from the fourth to the seventh day; and in nineteen cases collected by Bumm the swelling appeared generally about the sixth or seventh day. Malcolm recorded a case where, after ovariotomy, the parotid did not swell until the sixteenth day.

The onset is rarely attended by much disturbance of the general condition of the patient, though occasionally there may be a rigor. Usually there is a rise of temperature (102° F.), but high fever is the exception. The pulse-rate increases to 120.

Often the parotitis merely complicates the convalescence a little by the pain and slight fever induced, but at times the pain becomes most intense, and the discharge from Stenson's duct may be very irritating, and cause a constant tickling in the throat, the fauces becoming red and inflamed. The patient is not able to open her mouth, and cannot rotate her head without causing pain.

The swelling may occur on the same side on which the ovary has been operated on, or on the opposite, or on both sides. Thus, in two out of six cases where the side was specified, the opposite parotid was attacked. In four cases of single ovariotomy both glands were inflamed; in two of double ovariotomy only one parotid was affected.†

Other salivary glands besides the parotid may be involved, and in two cases reported by Bumm, the submaxillary and sublingual glands were involved. In one of our cases after hysterectomy the submaxillary glands were involved about the eighteenth day after the operation.

The termination is by resolution or suppuration, and where death does occur it is not due—according to Paget—to the suppuration of the parotid, but to old age, cancer, septicæmia, or pyæmia; and Paget held that in the cases that he collected the patients did not die because the parotitis went on to suppura-

* *Australian Medical Gazette*, October 20, 1900.

† Bumm, *Centralbl. f. Gynäk.*, No. 44, 1887.

tion, but the parotid suppurated because the patient was going to die.

Suppuration appears to occur in at least 50 per cent. of the cases, and the abscess then bursts into the auditory meatus, or it may burrow back over the mastoid process, or down the neck, or it may burst into the mouth. In a case reported by Bantock the notes state that 'the pus was escaping from the ear, and next day two small abscesses below the lobe of the ear were incised.'

In a case of sarcoma of the mesentery operated on by Thornton, which developed parotitis on the seventh day after the operation and died on the tenth day, Paget was able to make an autopsy. The parotid was found on section to be evenly infiltrated, not with pus, but with reddish, slightly turbid serous fluid. There was no pus in the gland itself, but at the proximal end of the duct there were a few drops of pus. The microscope showed the acini and lymph spaces of the gland invaded by masses of small round cells, which here and there could be seen inside the acini and ducts. It was a true inflammation of the gland itself.

In a case reported by Malcolm, he lays stress on the fact that the ostium of Stenson's duct was in contact with a decayed tooth, and was obviously inflamed and dry.

Bumm found *Staphylococcus aureus* in one case where the parotid suppurated.

Causation.—A few cases of post-operative parotitis may be explained by attributing them to 'mumps' when that affection is epidemic, but a few cases only can be thus explained.

It can hardly be denied that parotitis may be caused by the entrance of germs into the gland by way of the blood or from the mouth, and therefore we are forced to admit that some cases of parotitis are due to septicæmia, and we know that parotitis may be the first manifestation of pyæmia. In glancing through the histories of cases of ovariotomy which were performed twenty years ago, we can hardly doubt that generalized sepsis played an important rôle in those days in the causation of parotitis; while a local septic focus, such as a decayed tooth, may even now be the occasional cause.

Malcolm gives the following as his views on the causation of parotitis after sections: 'It seems to me probable that a direct septic infection from the mouth may account for the parotitis in some cases, and perhaps in all. There is no doubt that the con-

ditions under which the patient is usually placed contribute very materially to the occurrence of such an infection. The patient is made to retain the dorsal position for a time, and thus the force of gravity tends to prevent the emptying of the parotid ducts. The diet is at first liquid, hence the jaws are not used in chewing, and thus another powerful aid to the emptying of the ducts of the glands—namely, the intermittent pressure of the muscle—is in abeyance. The feverish condition following the operation, by reducing the quantity of the secretion, leads to a still further stagnation. The dryness of the mouth in fever is well known. Under such circumstances septic organisms in the mouth must be far more likely to affect the parotid gland than under normal conditions. Moreover, it is often extremely difficult to give the desirable attention to cleansing the teeth for some days after an operation without inducing nausea.'

We are inclined to think that the secretion of the parotid is affected after every section, and that this is one of the factors in producing the thirst that follows all section cases. Paulow long since showed that, if a loop of intestine be kept drawn out from the peritoneal cavity, the secretion of saliva is arrested. If we observe our patients attentively we shall find that the parched condition of the mouth is usually directly in proportion to the severity of the operation, and that in some cases, especially after the removal of 'pus-tube,' the lips of the patient become very sore—even when vomiting is absent—through the saliva excoriating them. In other cases the patient complains of a marked increase in the quantity of saliva after the first day, and this pours out into the mouth and scalds the fauces.

This irritation of the mouth by the saliva may at times serve to irritate the parotid, inasmuch as there are lymphatics which run from the mucous membrane of the mouth to a few lymphatic glands deeply placed in the substance of the parotid.

An overwhelming amount of evidence forces us to admit that there is an intimate association or sympathy between the parotid glands and the abdominal organs, whether digestive or generative, and that any interference with these organs either by disease or by operations may cause the parotids to be affected (reflexly ?).

Thus parotitis has been frequently observed to follow gastric ulcer, gastrostomy, duodenal ulcer, enterostomy, typhlitis, colotomy, herniotomy, abortion, pelvic abscess, operations for

lacerated cervix, introduction of pessaries, passage of catheters, pregnancy, Cæsarean section, hysterectomy, and ovariotomy.

These operations and diseases at times cause an increase, and at other times a decrease, in the quantity of the saliva secreted, while the quality of the saliva may be affected. Exceptionally we get a swelling of the parotid, no doubt due to vaso-motor changes, and these changes are in some cases followed by suppuration of the gland, an event which is most likely to happen if the patient is debilitated, or if Stenson's duct opens near to a septic focus, such as a decayed tooth, while occasionally the parotitis is due to a general septicæmia, and more rarely still it is associated with pyæmia.

Kelly says that he has known parotitis to follow when the jaw of a patient has been forcibly pulled forward during the administration of the anæsthetic; and in one of our own cases —a pregnant woman from whom we removed some gall-stones— this appeared to have been the cause of a slight parotitis, which set in on the day following the operation.*

Treatment.—The treatment consists in applying soothing applications, such as glycerine and belladonna; morphine ($\frac{1}{8}$ grain), may be injected when the pain is severe. The mouth may be gargled with boracic acid lotion, and if there are any decayed teeth in the neighbourhood of Stenson's duct the teeth and gums may be well cleansed with peroxide of hydrogen.

A brisk purgative may be administered. Liquid food should be given, as any movement of the jaws causes pain in severe cases.

Should the pain increase and suppuration be suspected, then the capsule of the parotid should be incised and the abscess opened by making a small incision in the skin and deep fascia over the angle of the jaw, and then pushing in a sinus forceps, after which a drainage-tube may be inserted, and we may apply boracic fomentations.

Even if no pus is found, early incision gives relief. This is well shown in a case reported by Von Preuschen. Ovariotomy had been performed, and on the third day a swelling in the region of the right parotid was observed, which rapidly increased.

* We have lately had a case of parotitis following a vaginal section for ruptured tubal pregnancy. We are certain that the parotitis, which set in on the evening of the operation, was due to the anæsthetist continually pushing up the angle of the jaw. The parotid suppurated.

Extensive œdema of the right side of the face transformed the eyelids into unsightly bags nearly the size of an apple. The submaxillary and sublingual glands were also affected. Difficulty of swallowing and breathing being very great, an incision was made in the parotid region. There was no pus, but the effect was surprising, a rapid decrease of the swelling taking place, and evident improvement in swallowing and breathing. Castor oil was afterwards given, and there was complete recovery.

Insanity.

In the early days of ovariotomy, traumatic delirium was a frequent complication ; many of the cases died because the delirum was due to sepsis, but in some instances, instead of a fatal result the delirium merged into a true psychosis.

As operations on the genital organs became more common, numerous instances were reported where the patient became insane, and consequently it became a prevalent notion that the removal of the ovaries was the direct cause of the insanity.

At the present time we know that after operations of every description—even after the mere administration of an anæsthetic—insanity has occurred ; and it is now generally conceded that insanity is not more common after operations on the reproductive organs than after operations on any other organs in cases where there is no inherited liability to mental disorder. 'On the other hand, if there be a psychopathic predisposition which has existed prior to and independently of the sexual disease, there is in such cases a larger percentage of post-operative mental disturbance than follows other operations.'*

Again, while both sexes are about equally affected in regard to numbers, yet the graver forms of mental disturbance occur after operations on the abdominal and pelvic organs in women.

When we think for one moment of the mental strain previous to the operation, of the effect of the operation, of the shock, pain, sepsis, and the joy of reaction, we are amazed that mental disturbances occur so rarely.

'The nature of the operation has little to do with the matter' (Dent), and 'insanity is more frequent after simple than after grave operations' (Kelly).

It is, however, well to bear in mind that 'a most marked predisposition exists in women who have been previously melancholy

* Macnaughton-Jones, 'Practical Points in Gynæcology,' p. 86.

and insane, and any patient with this blot in her history should only be operated upon in case of urgent necessity, and with the fullest explanation to the family as to the risk incurred' (Kelly).

The following case related by Professor Schauta to Macnaughton-Jones illustrates this point: A patient had a laparotomy performed for a right adnexal tumour, and subsequently to this a small polypus was removed from the womb. The patient recovered, but attempted suicide by chloroform. A year afterwards a myoma of the uterus having rapidly advanced, vaginal hysterectomy was performed, from which she recovered, but she finally succeeded in committing suicide. The patient had always been of a neurotic temperament, and her nervous condition was aggravated by unhappy marital relations.

Frequency.—Barwell* in 1885 was one of the first to direct attention to insanity occurring after ovariotomy, and he stated in his paper that Thornton had had two cases with this complication—one after ovariotomy and another after hysterectomy; that Keith, Dent, and Bancroft had had cases; while in the discussion Doran, Edis, and Meredith all mentioned cases that had occurred in their own practice after ovariotomy.

Hegar stated in a communication to Macnaughton-Jones that he had not observed any such cases among his operations, while Lapthorne Smith had seen none in 500 cases of abdominal sections. Homans had 2 cases in 1,000 laparotomies; Spencer Wells had 2 cases; while Keith in 64 hysterectomies, with removal of the ovaries, had 6 cases of insanity. Kelly has had 8 cases in 2,000 laparotomies. Tait, Christopher Martin, and Butler-Smyth have had this complication after their operations; the latter had 2 cases of mania in 54 ovariotomies. Savage collected records of 4 instances out of 483 cases of double salpingo-oöphorectomies.

Type of Insanity.—'In speaking of post-operative insanity it must be borne in mind that there is no special form of mental disturbance to which this name can be applied. We mean post-operative insanity **etiologically** and not **clinically**. The manifestations may be maniacal, depressive, or paretic. In the majority of cases the type is that of confusional insanity. Excluding those cases due to shock, the anæsthetic used, the toxic influence of chemical antiseptics, or internal remedies, and the cases properly classed as climacteric insanity, most of the

* *British Medical Journal*, March, 1885.

remainder, which includes the majority of cases, are due to toxæmia from septic conditions.'*

At the Congress of Alienists, held in France in 1898, the opinion expressed by Rayneau was that there did not exist a psychosis which might be called post-operative insanity, and that the main rôle in the production of post-operative mental disturbances was played by a predisposition, acquired or hereditary.

It would appear, then, that the essential condition for a development of insanity after cœliotomy must be in all cases a neurotic organization, predisposed, either from hereditary taint or from acquired nervous weakness, to take on diseased action in consequence of any active disturbing influence (Hurd).

Symptoms.—The mental disturbance takes various forms. In some cases it is a mania in which there is exaltation of some of the mental faculties, the patients appreciating perfectly their surroundings; perception seems preternaturally acute.

Another form is confusional insanity, and in this there is from the beginning evident intellectual impairment. Memory is impaired or practically abolished; the acts of mischief and violence are done without any apparent purpose (Worcester).

The symptoms may set in immediately when due to the anæsthetic, or a few days or a few weeks after the operation. The following cases recorded by Croom † will serve to illustrate this complication:

A married woman, in apparently robust health, with a simple ovarian tumour, which was removed without difficulty by an operation lasting ten minutes, became violently maniacal on the following day, had to be held down in bed, and died of exhaustion in four days. The necropsy showed no trace of sepsis, so the case was not one of mania or delirium of sepsis. There was no history of insanity, and the patient was apparently in excellent health.

In another case a troublesome ovariotomy had been performed; there were numerous adhesions; an excellent recovery was made, and the patient remained absolutely well for five days. On the morning of the seventh day, when the stitches were removed, the wound had completely healed except for one

* Rohé, 'Post-operative Insanity' (*American Journal of Obstetrics*, vol. i., 1899).

† *British Medical Journal*, March 2, 1901.

small suppurating hole. The same evening she became excited. The next day she was still more so, and a day later she became acutely maniacal and remained so for a week, when she had to be removed from the house. She died shortly afterwards.

In a third case after hysterectomy had been performed for a large fibroid, the patient appeared well after the operation. On the night of the seventh day, after the stitches had been removed, while the nurse had left the patient for a minute, she jumped out of bed, tore off the dressing, and before she could be brought back to bed the strapping had given way. This allowed the wound to reopen at its lower margin, and a small portion of the gut escaped. With difficulty she was anæsthetized, and the temporary hernia dealt with. She recovered from the operation only to become an inmate of an asylum.

Rohé reports a case operated on in France. A cœliotomy was performed, the appendages removed, and hysteropexy completed. After the abdominal wound was closed a catheter was passed, and the bladder was found to have been partly removed. The patient was reopened, and a bladder extemporized. 'Eight days after the operation (the highest temperature having been 99·5° F.), mental disturbances resembling toxic delirium with terrifying hallucinations appeared. In a few days there came on mental confusion, intellectual and physical torpor, with melancholic delusions and hallucinations.'

In those cases in which the mental disturbance does not show until months after the operation, we must suppose that the removal of the ovaries leads to a condition of climacteric insanity. In one of Halliday Croom's cases he says: 'A simple and easy ovariotomy without complications. Six months later symptoms of dislike to her friends appeared, with evidences of suspicion and melancholy, and she has now for some time been confined in an asylum.'

Prognosis and Treatment.—The **prognosis** in the case of acute confusional insanity is generally favourable; 75 per cent. recover.

The recovery may take place in a few weeks, or only after several years. There is, as a rule, a slow progression from worse to better, from greater to less violence and noisiness; at other times the general symptoms of improvement are intervals of lucidity, which increase in frequency and duration. Not frequently the insanity is permanent (Kelly).

The **treatment** will be in the first place directed to conserving the patient's strength, as exhaustion is the chief danger in acute confusional insanity.

Rest in bed, easily digested food, and stimulants.

The insomnia and delirium are to be treated with opium, and, if possible, with warm baths.

Should any septic focus be present, such as a pelvic abscess, it must be attended to at once.

Ovarian extract has been tried with benefit in cases where the ovaries have been removed.

Iodoform-Poisoning.

In the early days of antiseptics, when the carbolic spray was in use, and antiseptics were freely employed during the course of the operation, carboluria was not an unfrequent complication during the after-treatment. We have noted one of Thornton's cases in the paragraphs dealing with kidney complications.

Iodoform-poisoning is not a common occurrence after a section, because drainage by gauze or by tubes is employed now much less frequently than formerly.*

We have seen some cases of poisoning after operations other than sections, and we have had one fatal case after a cœliotomy. The patient, a woman aged fifty-two years, was operated on for gall-stones. There were fourteen stones in the gall-bladder, and one in the cystic duct. The gall-bladder was very contracted and thickened, and it was completely hidden by a mass of adhesions and new growth, which involved the small intestine and transverse colon. After the gall-stones had been removed, it was found impossible to bring the opening in the gall-bladder up to the parietal incision, so a rubber drain was fixed in the bladder, and iodoform gauze was packed round to shut off the gall-bladder from the general cavity. After forty-eight hours the temperature was 98° F., but the pulse had risen to 160, and as the patient vomited continually, it appeared to us that the patient had either some obstruction or some septic trouble. The abdomen was very distended with gas. We reopened the wound, and also made an incision at right angles to it, parallel to the right rectus muscle. The iodoform gauze was removed, the parts were well irrigated with saline solution, and a coil of

* Stone, 'Iodoform and Carbolic Acid Intoxication' (*American Journal of Obstetrics*, January, 1902).

distended gut was withdrawn and fixed outside to the skin by means of safety-pins; some fresh iodoform gauze was packed in, and the patient was placed back in bed. The intestine was opened and drained, and this allowed the abdomen to become almost flat as the gases escaped; and after croton oil and cascara had been injected through the opening in the distal portion of the intestine, the bowels acted later on, much to the relief of the patient. The patient, however, continued to vomit, she was very restless, and it was noticed that there was a fine tremor in her hands and arms. The temperature continued low (96° F.), but the pulse-rate was high (170).

On the fifth day it was noticed that the discharge from the proximal end of the gut was black and tar-like, with a very disagreeable odour.

The patient now began to be very drowsy, and also to wander, and was delirious during the night-time. Suspecting iodoform-poisoning, we tested the urine by adding a little starch to it and then a few drops of nitric acid. Immediately a very marked blue ring appeared on the surface; this left no doubt that, no matter what other condition was present, the patient was certainly suffering from iodoform-poisoning. All the iodoform gauze was immediately removed and replaced by plain gauze, but the patient gradually became more drowsy, and died quietly on the seventh day after the operation.

In other cases suffering from iodoform absorption, the first point that has always attracted our attention is the drowsiness of the patient. The patient will begin to sleep during the day-time just as though she had been given morphia, and we find that after a time she cannot be roused entirely, and she does not comprehend rightly what is said to her, but will make vague replies to our questions. In some instances the patients became excited, and in one of our cases where the symptoms set in after the removal of a sarcoma of the breast the patient screamed regularly every five minutes in the most maniacal manner, and continued this for twenty-four hours. During this period she was quite unconscious of what was going on around her. Her urine was almost black, and during the last twelve hours there was anuria. She died on the fourth day after the operation. In this case iodoform had been used on a large raw surface, which had been freely swabbed with peroxide of hydrogen, as the tumour itself had, owing to a previous incision, become septic.

Diagnosis.—If iodoform has been used, we should immediately become suspicious if we find that on the fourth or fifth day, or even earlier, the patient is beginning to get very drowsy, and if at times her mind wanders.

If watched, we shall find that she lies and takes no notice of anything about her; she ceases to worry the nurse for drinks, and does not complain much of the pain of the tympanites, if there is much gas present.

In the case of a child aged seven years, in whom, after treating a large hydatid cyst of the abdomen according to Lindermann's method, we stuffed the cyst with iodoform gauze, and allowed it to remain for about ten days, the child developed a rash and became drowsy, and from her eyes and nose a clear fluid literally poured away for some days. A child in the next bed who had been operated on for hernia, and who had been admitted a week after the section had been performed on the first child, developed well-marked scarlet fever about this period, and we found it exceedingly difficult to decide whether our section case was suffering from mild iodoform absorption or from scarlet fever. The rash on her body was never very marked, and occurred about her chest; but her tongue was the typical strawberry tongue of scarlet fever. Her urine was abundant, and did not show any signs of albumin nor yet of iodoform. She continued to grow more drowsy, the coryza continued, her abdomen became very distended from tympanites, and she ultimately died of complete suppression of urine twenty-eight days after the operation, and fourteen days after the rash first appeared. It is probable that there was slight absorption of iodoform in the case, and that this turned the scale against the patient when the scarlet fever attacked her (as it did several other cases in the same ward). Before the urine ceased to be excreted it was highly albuminous.

Treatment — Prophylaxis. — In using iodoform gauze for drainage in the peritoneal cavity we shall have little to fear if we take the precaution to *wash our drain in a basin of sterilized water before we insert it.* Gauze that is purchased from well-known makers has seldom much iodoform in its meshes, but gauze that is made according to Kelly's directions, or according to other well-known recipes, has a considerable amount of iodoform powder in the meshes, and this escapes in the form of a powder when the gauze is unrolled. To use such gauze in any

quantity in the peritoneal cavity is only to run an unnecessary risk, and, as stated above, it should be *washed just before being introduced.*

Again, we believe that, in the case of iodoform-poisoning mentioned above which occurred after removing a sarcoma of the breast, and in another case when a large sinus in the dorsal muscles had been curetted, then swabbed with peroxide and stuffed with strong iodoform gauze, the symptoms of poisoning followed the use of quite small quantities of iodoform on account of using peroxide of hydrogen at the same time.

A large raw surface and very tight packing are conditions favourable for absorption.

We should, when the first symptoms of drowsiness or delirium present themselves, remove all iodoform from the wound; and if we are employing gauze drainage, if possible, irrigate the parts, and either drain with a tube or with plain gauze.

In the case of the hydatid cyst mentioned above we irrigated the cyst with a solution of starch and water in the hope that this would be of some benefit.

Murrell advises that the parts touched by the iodoform should be swabbed with oil of eucalyptus.

We might also swab the parts with ether.

Loebesch, according to Hare, asserts that the mental excitement of iodoform-poisoning cannot be quieted by narcotics. In the gall-stone case related above we administered morphine ($\frac{1}{8}$ grain), when the patient became very excited and restless, and tried to leave her bed on the fifth day after the operation, and the effect of this small injection was to cause the patient to sleep so soundly that the nurse roused her every two hours during the twelve hours she slept and administered black coffee, because she considered the patient was really suffering from morphine-poisoning.

In another case we administered chloroform, and the patient was much calmer for some hours.

Soulier recommends the administration of bicarbonate of soda to unite with the iodine, and so aid its elimination.

We gave our patient submammary injections, and put bicarbonate of soda into the injections, but to no purpose.

The patient should be kept warm, and sweating should be encouraged so as to relieve the kidneys, and dry cupping over the loins may be practised.

Glycosuria and Diabetic Coma.

In the paragraphs devoted to the preparation of the patient before the operation we have dwelt upon the seriousness of undertaking an operation when the patient is suffering from diabetes. There are some operators who regard this caution as one of the superstitions of surgery, and Baldy,* in discussing a paper by Noble, in which the latter operator related how he had operated on three patients suffering from diabetes, said: 'I have never yet had one that behaved badly. I have never yet had one in which the operation has increased the sugar in any shape or form, and I cannot see why there has been this inordinate fear of touching diabetic patients with the knife.'

In examining the histories of cases that have been operated on during the time when sugar was present in the urine, we must distinguish between patients suffering from glycosuria and from diabetes mellitus; and if we are careful to make this distinction we shall probably be able to account for the fact that many cases have been operated on successfully whose urine contained sugar.

The presence of sugar in the urine might hardly be a contra-indication to an operation on an elderly person of full habit, whereas in a young person the presence of sugar would cause us to exercise the greatest care.

Again, if it is found that the excretion of sugar can be largely controlled by diet, and we find that the glycosuria is of alimentary origin, then such a person is a more favourable subject than one in whom the diabetes is due to tissue disintegration.

There is some testimony to show that while patients whose urine is loaded with sugar, and who are undoubtedly suffering from diabetes mellitus, may be successfully operated on, and the cœliotomy may actually cure the diabetes, on the other hand, there is very abundant testimony to show that even a simple section may be followed by a fatal result, due to diabetic coma, when the patient is suffering from diabetes mellitus.

The following cases illustrate these remarks:

Beyea † operated on a case of multilocular pseudo-mucinous cyst-adenoma of the ovary in a patient whose urine had 7 per cent. of sugar, and who exhibited the clinical symptoms of

* *American Journal of Obstetrics*, February, 1899.

† *Ibid.*, February, 1900.

diabetes, and after the removal of the cystoma the sugar disappeared from the urine, and the diabetic symptoms also disappeared.

Halliday Croom* records a similar result.

Imlach† operated on a case of pyosalpinx in a patient whose urine was loaded with sugar, and she recovered, and the diabetes became cured.

In the three cases recorded by Noble, none of them were abdominal sections; two recovered, while after the third, a vaginal hysterectomy, 'the patient did well for four days, when the percentage of sugar and the amount of urine largely increased, symptoms of coma supervened, became rapidly worse, and the patient died of diabetic coma on the sixth day.‡

Goldspohn,§ in a series of 170 cases of Alexander's operation, in 95 cases of which in addition he performed bilateral inguinal cœliotomy, lost only 1 patient. In this case, while performing his modification of Alexander's operation, he resected the left ovary. The patient died in sixty hours in a diabetic coma. The operator was unaware of the fact that the patient was suffering from diabetes, as the urine of another patient had by a mistake been examined for hers, and it was not until after the operation that it was discovered that the patient had diabetes.

Symptoms.—Small quantities of sugar may be found in the urine after many operations when chloroform has been the anæsthetic, but this temporary glycosuria soon disappears.

When, however, the patient is suffering from diabetes mellitus before the operation, the quantity of sugar may increase, or it may rapidly decrease, or the decrease may be very gradual. In Imlach's case, referred to above, an examination on May 16 showed that 1,200 grains of sugar were excreted. The section was performed on May 19, and on May 26 the sugar had disappeared from the urine. In Croom's case a specimen of the urine examined on the morning of the operation contained 12 grains of sugar per ounce. The operation was performed on December 12, and on March 28 an examination of the urine showed it to be 'absolutely free from any trace of sugar.'

* *British Gynæcological Journal*, February, 1896.
† *British Medical Journal*, July 11, 1885.
‡ *American Journal of Obstetrics*, February, 1899.
§ *Ibid.*, May, 1900.

When after an operation diabetic coma sets in, the symptoms begin to show during the first week. The respirations become accelerated or disturbed, the patient becomes restless, and delirious or maniacal. The pulse becomes very rapid and feeble. As the drowsiness sets in the breathing is 30 or 40 per minute, the pulse 130 to 180, and there is deep sighing respiration. The face is pale, body and extremities cold, and the temperature becomes subnormal. The bowels do not act, little urine is passed, and this is often albuminous, and contains acetone. Recovery is very rare, and treatment consists in getting the bowels to act freely, and administering citrate of potash and submammary injections of saline solution.

CHAPTER LIII

RARE COMPLICATIONS

Emphysema of the Abdominal Wall.—Emphysema occurring between the layers of the abdominal parietes is not a frequent complication, although it occurs more commonly than the literature of the subject would lead us to suppose, if we are to judge from the cases quoted by individual speakers when this subject is brought up for discussion. Thus, when in 1895 Meinert* read a paper on the subject, he was able to collect eight reported cases. Leopold said that he had seen six cases, and Brosin said he had seen three or four cases. We ourselves have seen four cases.

Emphysema is met with in two forms; one is of no consequence, while the other is of great moment.

The four cases that we have seen belong to the mild class. Here a day or more after the section has been performed, and the dressings have been removed in order that the abdomen may be palpated, one finds on pressure an area near to the abdominal incision which when pressed upon immediately gives us the impression that there is air in the tissues. Leopold, in discussing Meinert's paper, said that he thought that the emphysema occurred between the peritoneum and the muscle, but this observation is probably not correct. In one of our cases, a woman with malignant disease of the ovaries—and, as the post-mortem showed, of the stomach also—upon whom we operated, developed a well-marked patch of emphysema to the left side of the incision. She died forty-eight hours after the operation, and we made a careful dissection of the area, and found that the emphysema was in the cellular tissue, situated between the skin and the aponeurosis of the rectus. The bullæ were small, and when pressed upon the air escaped, and the tissue could be

* *Centralbl. f. Gynäk.*, No. 50, 1895.

smoothed out into an even layer. In this case the Trendelenburg position had not been employed, but as the patient was very weak at the time of the operation, and had developed peritonitis, we left some saline fluid in the abdominal cavity. She vomited continuously for twenty-four hours—had, in fact, hæmatemesis—and the dressings were saturated with the fluid that had been forced through the abdominal wound, it having been closed by through-and-through sutures only. It appeared to us that the real cause of the emphysema was the forcing of the fluid from the peritoneal cavity into the subcutaneous tissues; the fluid had become absorbed, and air had remained.

In another case in which we noticed emphysema the Trendelenburg position had been used, but the peritoneal cavity had not been irrigated, and the abdominal wound had been closed in layers.

Heil thinks from his experiments that the condition only occurs after imperfect closure of the peritoneal layer.

Madalener has reported some cases, and he believes that the emphysema is due to the Trendelenburg position, and he considers that it would be advisable to lower the patient before closing the abdominal cavity.

These cases of emphysema, probably due to a mere accidental forcing of the air into the tissues, are without danger. Leopold thought that there was an increase in the rapidity of the pulse, and that the patient had some pain and was restless, but the condition need cause no anxiety unless the emphysema begins to spread. When this occurs we must immediately make one small incision into the affected tissues, and examine for the *Bacillus aërogenes capsulatus*, first discovered by Welsh, but now believed by Schattenfroh and Grassberger to be identical with the *B. phlegmon emphysema* of Fraenkel and the non-mobile form of the butyric acid bacillus. If the examination should prove negative, then we need not be alarmed if the emphysema spreads up even to the costal margin or to the axillæ, as in one of Leopold's cases, or down to the symphysis pubis; air, in fact, may be forced out of the tissues for five weeks after the onset of the condition (Weller, Van Hook).

On the other hand, if the bacillus above-mentioned be discovered, we must lose no time in making extensive incisions and employing irrigation, and the abdominal wound will need to be opened and also irrigated; for if the disease advances, the

pulse and temperature increase—death may follow; then an examination of all the organs will show the presence of the *B. capsulatus*.

It has been suggested that the *B. aërogenes capsulatus* has no pathogenic properties in man when in healthy tissues, but if the tissues are much damaged it behaves as a toxic saprophyte. When, however, there is a mixed infection we may get marked spreading inflammation, which, if allowed to spread, may convert the whole body into an emphysematous mass.

Malaria. — Occasionally, when the patient is progressing favourably, a few days or a few weeks after the operation she is attacked with chills, headache and backache, and her temperature shoots up to 103° F. or higher.

The surgeon may be thrown off his guard, and think that his patient has developed an extraperitoneal hæmatocele, or that a pelvic abscess is forming.

An examination of the blood will, however, reveal the *Plasmodium malariæ*.

Abortion may occur soon after a section, especially if the uterus has been injured during the operation. Mason, in performing ovariotomy on a single woman, punctured a gravid uterus. The patient aborted next day, and death occurred six hours later. The same accident happened to Pollock, who stabbed the gravid uterus in mistake for an ovarian tumour. Soon after the operation the patient gave birth to a dead fœtus, and then died within a few hours.

Bowel disturbances may occur during convalescence. D'Antona had a death from gastro-enteritis on the twelfth day after removing a sarcoma of the ovary. The gastro-enteritis was attributed to an error in diet.

In Wells's second case diarrhœa set in on the third day, and his one hundred and third case was complicated by seven attacks of diarrhœa. The patient also suffered much from **bed-sores.**

Billroth had grave collapse a week after an ovariotomy, due to intestinal hæmorrhage, which he attributed to embolism of the superior mesenteric artery.

Endocarditis. — Cullingworth mentions an instance when, after removing a pyosalpinx, the convalescence was interrupted by acute endocarditis. In one of our patients, after performing Alexander's operation, endocarditis developed, and the pulse ran up to 218. The patient recovered.

Fevers.—Relapsing fever developed after Rindovski had performed ovariotomy, while one of Price's patients was attacked by enteric fever. Hamilton has recorded a case of rheumatic fever after ovariotomy.

Gall-Stones.—Owen had a death after ovariotomy which he attributed to obstruction of the gall-duct by a biliary calculus.

Heart Disease.—Noeggerath had a death after ovariotomy due to 'paralysis of the heart, which was found to be in a state of fatty degeneration.'

Doran has drawn attention to severe attacks of palpitation that some women suffer from after cœliotomy.

Hernia.—Wenzel had the stump of the pedicle protruding through the abdominal cicatrix three years after an ovariotomy.

Da Costa in one case had to perform herniotomy four days after an ovariotomy, and a femoral hernia came down in one of Cripps's cases while the patient was in bed after an ovariotomy.

Hysteria.—Wells and others have described cases when after the operation the patient has become very hysterical, has thrown herself about, and torn off her bandage.

Other nerve disturbances that have been noticed are severe attacks of sciatica (Wells) ; spasmodic contraction of the recti, which appear almost tetanic (Wells) ; sudden development of aphasia (Saltzmann) ; an attack of hemiplegia, spastic contraction of the right hand being marked (Doran).

Jaundice.—Koeberbte called attention to the occurrence of icterus after ovariotomy. A perusal of Wells's cases shows how often it was a symptom of septic trouble, while Ingraham* says that at one time jaundice occurred in his practice in 8 per cent. of his section cases.

Stomach.—Helmith had a case of acute dilatation of the stomach following a section.

Gangrene about the Breast.—In a case operated on by us, a needle that had been kept in pure lysol was inserted by the nurse below the breast in order to inject some saline after the operation. In a few days' time a slough formed, and on this being removed the breast and the muscles were exposed over a space 5 inches by 3 inches. It was evidently the pure lysol contained in the needle, which was a large one, had been the cause of this accident, because this needle was taken from one breast and inserted under the other, but no bad effect was

* *American Journal of Obstetrics*, vol. ii., 1900.

noticed because the lysol had been washed out of the needle by the first injection.

Fungus Growth after Abdominal Section.*—West performed cœliotomy and removed an ovarian cyst. On the tenth day after the operation the house-surgeon looked at the wound, and it was entered in the history-book that the union was perfect. On the fourteenth day the patient complained that she felt a sticking sensation in the abdomen. On removing the dressing a most remarkable growth became visible at the wound. The growth stood out a distance of 2½ inches from the wound, and grew well up into the dressing. It had a pedicle ½ inch in diameter and 1½ inches long, and the body cupped like that of a mushroom. The pedicle and underpart of the growth were covered with bluish epithelium, apparently skin, which ceased at the periphery of the expanded part. The top of the growth was bright red in colour, like a strawberry. The growth presented a remarkable appearance, like a fungus on a log of wood. After three days the growth had undergone a retrograde metamorphosis. It was no longer the startling growth it had been, but it had dwindled down to a mass 1 and 1½ inches from the abdomen with a distinct pedicle, and the epithelium or skin which appeared to surround it had disappeared entirely.

* West, *American Journal of Obstetrics*, January, 1902, p. 116.

CHAPTER LIV

POST-OPERATIVE HERNIA

Definition.—Ventral herniæ, incisional herniæ, or herniæ of the linea alba, are terms applied to those herniæ which are formed by the projection of a portion of one or more viscera completely between the edges of the recti muscles, in consequence of the distension of the cicatrix, as well as the want of primary union of the aponeurotic edges.*

Time and Frequency of Occurrence.—Herniæ may occur a few months after a section, or they may not make their appearance for years after.

Dr. May Thorne† has collected some statistics to show the time of occurrence of herniæ after the operation:

Cases.	Time after Original Laparotomy.	Cases.	Time after Original Laparotomy.
2	14 years.	1	2½ years.
1	10 ,,	2	2 ,,
1	9 ,,	2	1½ ,,
1	8 ,,	3	1 year.
1	7 ,,	1	5 months.
2	5 ,,	1	4 ,,
3	4 ,,	2	few ,,
3	3 ,,		

Abel found that 38 per cent. occurred within the first half-year; 26 per cent. within the second half-year; 13 per cent. within the second year; 23 per cent. still later.

Prochownick says that incisional herniæ occur as follows: Four-sevenths in first year; two-sevenths in second year; and one-seventh in third or later years after operation.

All surgeons admit that post-operative herniæ in the linea alba

* La Torre, *British Gynæcological Journal*, vol. xii., p. 397.

† *British Medical Journal*, February 4, 1899.

occur very frequently, but it is exceedingly difficult to arrive at true statistics, because few operators take the trouble to trace their cases for a series of years, and no statistics are of value where the condition of the case is not ascertained three years after the operation.

There is a general agreement that herniæ do not occur so frequently now as formerly, and that the three factors that have mainly contributed to the better results are (*a*) the aseptic healing of the incision; (*b*) the abolition of the drainage-tube; (*c*) the closing of the abdominal incision by approximating layer to layer by means of tiers of sutures.

In spite, however, of the better results, it appears to us after examining a large number of statistics that even the most successful surgeons have about 8 per cent. of herniæ, while the rank and file of operators have results which range between 15 and 30 per cent. Writers in every country bewail the frequency of this complication.

Lapton Smith says that at the New York Hospital for the Ruptured and Crippled, the surgeons report an appalling number of patients applying to them for relief of ventral herniæ after cœliotomy.

Greig Smith held that the complication occurred in 20 per cent. of all section cases operated on five years and upwards. Abel's* statistics are appalling.

The figures for incisions healed by primary union are :

	Cases.	Herniæ.	Per Cent.
With inclusive sutures	61	18	29·0
,, muscle sutures	25	6	24·0
,, fascia sutures	224	20	8·9

The cases of isolated fascia suture show slight variations according so the preparation of the suture material :

	Cases.	Herniæ.	Per Cent.
With chromic acid catgut	85	7	8·3
,, sublimate alcohol catgut	30	3	10·0
,, xylol alcohol catgut	59	7	11·9
,, cumol alcohol catgut	50	3	6·0

These figures prove the superiority of isolated fascia suture.

* *Archiv f. Gynäk.*, vol. lvi., sec. 3, p. 656; *British Gynæcological Journal*, vol. xiv., p. 447.

These are his figures for multiple herniæ:

	Cases.		Herniæ.		Per Cent.
With inclusive sutures	61	...	6	...	10·0
,, isolated fascia sutures ...	224	...	4	...	1·8

After infection of the incision:

	Cases.		Herniæ.		Per Cent.
With inclusive sutures	50	...	34	...	68·0
,, muscle sutures	27	...	18	...	64·0
,, fascia sutures	52	...	16	...	31·0
,, superficial suppuration ...	33	...	15	...	45·5
,, deep suppuration	16	...	13	...	81·0

Etiology.—La Torre classes the causes of herniæ under **determining** and **occasional.** The former causes are a thin cicatrix, wanting in firmness, and an opening in the musculo-aponeurotic plane; the latter are all those circumstances which retard the union of the wound, which favour distension and laceration of the cicatrix, and which tend to promote union by second intention.

From a clinical point of view the causes may be **direct** or **indirect.**

The **direct** causes may be subdivided into three classes:

1. Those that prevent union of the edges of the wound in the aponeurosis, such as when sutures are so badly applied that it is impossible to properly coapt the edges of the wound, or when the stitches are so far apart that fat or peritoneum projects between them.

2. Those that promote union of the whole or part of the wound in the aponeurosis by second intention; such causes are suppuration and drainage.

3. Those that stretch the cicatrix, such as abnormal intra-abdominal pressure, enormous distension by tumours, growths and large deposit of fat in the thickness of the abdominal walls.

The **indirect** causes include all those circumstances which predispose to the rupture of the cicatrix, such as removing the sutures, or permitting the patient to get up too soon, and the neglect of the patient to wear an abdominal belt (although some deny that the belt has any influence), or the use of sutures that become absorbed before the cicatrix has become firm.

The length of the incision has an influence in the production of herniæ; the longer the incision the more frequent the herniæ.

Abel found that the cicatrix remained absolutely stable in cases of primary union as follows:

Length of Incision.	Inclusive and Muscle Sutures per Cent.	Fascial Sutures per Cent.
9–11 centimetres	100	100
12–15 ,,	84	92
16–19 ,,	53	96
20–23 ,,	50	67

The **length** of the incision influences not only the percentage of herniæ, but also the **number** of openings and the **size** of these openings.

Herniæ occur at any part of the cicatrix, intestine, or omentum, inserting itself wherever a weak spot happens to be. Herniæ, however, occur more frequently at the pubic end of the cicatrix than at the umbilical extremity; the arrangement of the fascia of the recti as the symphysis pubis is approached no doubt explains the frequency. This is also the position of the stump in the extraperitoneal treatment of the pedicle, or the position when a cyst wall is fixed, and also where the drainage-tube and gauze emerge, and where suppuration occurs most frequently.

This also is the spot where cases of tubercular peritonitis are drained, and such cases are frequently followed by herniæ, because the wound heals by unhealthy granulations.

Herniæ increase with the **duration of suppuration**, but deep suppuration is a more potent factor in producing herniæ than superficial suppuration, because the deep lying-layers of fascia are involved in the former case, but not in the latter.

Abel has arranged some of his cases according to the duration of the suppuration process as follows:

	Cases.	Herniæ.	Per Cent.
2 weeks' suppuration	40	16	40
3 ,, ,,	35	19	54
4 ,, ,,	20	13	65
Over 4 weeks' suppuration	25	20	80

The **size** of the hernia also depends largely upon the **duration** of the suppurative process.

It is a common observation that women who have fat abdominal walls more frequently develop herniæ than thin women. Olshausen considers, however, that women with thin abdominal walls are very liable to develop herniæ, but careful observations have shown that this is not the case.

It has been suggested that the chief cause lies in the fact that in stout women fascial layers are more difficult to approximate than in thin subjects.

August Martin maintains that the condition of nutrition of the patient, her work, and the tone of her tissues, are the deciding factors as regards herniæ, but it is more probable that mere vigour of body does not give any advantage as regards the percentage of herniæ after primary union, although it has a decided influence in those cases when the incision has been infected.

Abel says that anæmia has no appreciable effect, and age has a very slight effect, those under twenty having a slight advantage over those above twenty years, but those over fifty are better than those between twenty and twenty-five.

Pregnancy, although considered as a potent factor in the causation of post-operative herniæ, has not a great influence, no matter whether it occurs immediately or remotely after the operation, provided that the fascia has been sutured separately. That the cicatrix should stand does not appear so strange when we remember that the cicatrix in a uterus that has been subjected to Cæsarean section is proof against the distension of a subsequent pregnancy.

Anatomy of Incisional Herniæ.

In its simplest form an incisional hernia consists of but a simple stretching of scar-tissue. This is brought about, after suppuration, by the destruction of the fat overlying the fascia and by the necrosis of the superficial fascia, which is replaced by scar-tissue, which in time becomes stretched, and so allows a prominence to form. It is not uncommon in cases where the patient gains weight rapidly and the girth of the abdomen increases; the scar then yields. In other cases the wound may have healed by first intention, but at one or more spots along the line of junction of the fascial layers there has occurred an opening, either because the edges of the fascia have not met or, having met, have retracted, or because a portion of muscle or peritoneum has become interposed between the layers of fascia. Into the opening the extraperitoneal fat sooner or later finds its way, and prepares the path for the process of peritoneum and omentum to follow. In many cases the patient may be unconscious of the presence of such a small hernia, and when examined

the openings may not even be patulous to the finger-tip on palpation.

When the hernia grows larger it is due to a stretching of the scar-tissue, and when well established consists of the skin stretched and often deeply pigmented, beneath which there is little or much fat, and the dense layer of cicatricial tissue, which has become gradually thinned and expanded, is often closely adherent to the skin at many places. Beneath the fibrous layer is the peritoneal pouch. In these simple cases there is usually no neck, as there is in an umbilical hernia, nor do the intestines burrow to the side beneath the skin.

This description applies only to small herniæ. When the hernia is of considerable size it may have a tense narrow neck and secondary sacs, and there may be burrowing of omentum and intestine as in an umbilical hernia.* Frequently the intestine or omentum adheres to the parietes behind the neck of the sac and also to the sac wall, and in palpating the hernial aperture the edge may be felt sharp in the greater part of its periphery; but at one spot an indistinct soft body may be made out, which indicates adherent bowel or omentum. In some cases a serous exudate forms in the sac and helps to fill it.

In some cases there is no true neck to the main sac, but secondary sacs may be found either running under the skin or under the rectus muscle, and these sacs are filled with omentum.

In one case that Doran operated on the hernial pouch was pear-shaped and nearly 5 inches long, including the entire cicatrix. The hernia was double, and the operator could feel an elliptical gap 1 inch long in the aponeurotic layer near the upper part of the wound, and another admitting the top of the forefinger at the lower angle. On coughing, intestine could be felt issuing from both gaps, and the whole cicatrix bulged forward as a large sac.

Macnaughton-Jones gives a photograph of a case operated on by Bumm, which shows two post-operative herniæ as large as two fists side by side in the line of the incision.†

The sac may contain only a knuckle of intestine or a small ball of omentum, while in other cases there is present some of the transverse colon (Doran), the pregnant uterus (Kelly), the cæcum and vermiform appendix, the right and transverse colon,

* Doran, *Lancet*, November 27, 1897.

† *British Gynæcological Journal*, February, 1902.

the whole of the great omentum, and about 2 feet of ileum (Lockwood).

The size of the hernia depends largely on the length of time that the suppuration existed after the operation. Abel's table brings this fact out very clearly.

HERNIAL OPENING OVER THE SIZE OF A SILVER DOLLAR.

	Cases.	Times.	Per Cent.
2 weeks' suppuration	40	4	10
3 ,, ,,	35	6	17
4 ,, ,,	20	6	30
Over 4 weeks' suppuration	25	5	31
,, 6 ,, ,,	9	5	56

As remarked above, the majority of herniæ occur in the lower third of the incision below the semilunar line of Douglas.

In some cases the herniæ, instead of coming through the scar left by the incision, are found in the suture tracks.

Bröse recently exhibited a patient in Berlin who had three suture-track herniæ at the lower end of the abdominal cicatrix. The wound itself was firmly united. The cause of such herniæ is the horizontal broadening of the suture track, caused by the cutting of the suture through the deep layers; the linear cicatrices thus formed after a time became stretched and weakened. The neck of the sac is by the nature of the complication broad horizontally and narrow vertically.*

Symptoms and Diagnosis.—The small herniæ cause so little trouble that the patient is often unconscious of their presence. Those herniæ which contain omentum give rise to less pain than those containing bowel, and the larger the hernia is in proportion to its neck, the more the trouble. At times the patient may be seized with all the symptoms of intestinal obstruction due to strangulation of the bowel in the hernia.

The diagnosis is simple; in some instances it will be necessary, however, to stand the patient up and ask her to cough before we can ascertain whether the scar is quite free from any weak spots, and it will be necessary to use palpation to find the fine omental herniæ, which do not bulge sufficiently to be detected by the eye.

Prognosis.—In considering the prognosis, we find that small herniæ have no tendency to increase in over 30 per cent. of cases after the third year.

Medium-sized (less than the size of the fist) herniæ tend to

* *British Medical Journal*, Epitome, June 1, 1901.

increase in at least 80 per cent. of cases even after the third year, while very large herniæ almost invariably increase in size year after year.

Should the omentum fill the hernial sac completely and adhere to the neck and walls, the patient may be considered quite safe, for then nothing else can enter the sac.

If, however, the patient is subject to attacks of vomiting, and we have a difficulty in reducing the contents, the patient should be warned that there is a danger of strangulation, and an operation should be insisted upon, unless the patient is excessively fat, when the danger of the operation is very great, as such a patient often has a fatty heart.

A ventral hernia may become strangulated many years after the original operation. Kelly was once called upon to operate on a patient aged seventy-five years who had had an ovariotomy performed on her twenty-seven years previously. She suffered from frequent mild attacks of obstruction, until the final severe attack of complete obstruction in which Kelly saw her. She was then vomiting fæcal matter, and while under the anæsthetic, being prepared for an operation on the irreducible hernia, she suddenly poured out such a deluge of fæcal matter into her throat and nose that she died at once of suffocation.

Treatment—Prophylaxis.—Inasmuch as a hernia may cause a patient a great amount of local and reflex discomfort, prevent her earning her living, prove more troublesome than the affection for which the original operation was performed, and in some cases actually cause her death, it is necessary to consider how we may prevent this unfortunate and only too common complication.

The key-note to the problem of the prevention of incisional herniæ is in obtaining a **primary firm union** of the **aponeurosis** covering the recti muscles.

In order that we may obtain primary union, we must have healing without septic complications. If the case is a clean one, we may achieve this by our modern means, and in this we have the advantage of our predecessors, who were handicapped even in their most simple cases. If the case is a septic one, or becomes so from bad technique, then we must expect a weakened union, 'and it is not always recognised that after suppuration a longer time is needed for thorough cicatrization' (Lockwood).

When a drainage-tube is employed the spot often becomes septic, and if not septic the edges of the aponeurosis fail to come together, and the spot is closed by granulation tissue and remains weak.

But while firm union of the aponeurotic layer is the chief point to be aimed at, 'the best method of closure is that which brings the tissues into exact approximation, layer by layer, in the order they occupied before division, and holds them there until firmly united with the least risk of infection' (Kelly).

What form of suture, therefore, will coapt the several layers most accurately, and bring together in apposition the broadest raw surfaces, and maintain these surfaces in accurate apposition longest? This question is answered, in our opinion, thus:

Each layer of tissue should be sutured separately in order that we may be absolutely certain that the divided layers are in accurate apposition. Accordingly, the peritoneum is closed by a continuous suture of silk, catgut, or wallaby tendon. An absorbable suture is to be preferred, because the peritoneum takes but seven days to heal firmly. The edges of the anterior layer of the aponeurosis of the recti muscles are united by chromic gut, silk, bronze, aluminium wire, or silver wire, as the muscles and fasciæ take fourteen days to firmly unite.

If the subcutaneous fat forms a thick layer its divided surfaces should be drawn together, so that no dead spaces remain where blood may collect and become infected. Lastly, the skin edges may be united by a continuous suture of horsehair, or interrupted suture of silkworm gut; but since the *Staphylococcus epidermis albus* may still remain even after cleansing the skin most carefully, it is wiser to avert the chance of even superficial suppuration by employing a subcuticular suture of chromic catgut, because the skin edges take eighteen days before they are firmly united.

There can be little doubt that the method of closing the abdominal wound by layers of sutures is the one that is growing in favour year by year, but there are many well-known surgeons who still adhere to the old method of closing the wound by means of through-and-through sutures of silk-worm gut, and the reasons they urge are as follows:

Much time is wasted at the end of the operation by inserting tiers of sutures, the sutures devascularize the lines of union and narrow them, and there is not the flush meeting of the whole of

the rawed surface as when mass sutures are employed. The catgut that is so often used becomes softened at the end of seven days, and it offers them no resistance to the separation of the aponeurosis, which, being poor in bloodvessels, takes weeks before it is firmly united. When, on the other hand, non-absorbable suture material is employed, such as silk, silk-worm gut, chromic gut, and silver wire, it cuts through the aponeurosis on one side, so that it no longer holds the two edges in apposition, and these buried sutures cause suppuration in the wound in at least 3 per cent.* of cases, and the trouble may not start for months or years after the operation. They say that the use of buried sutures are inadmissible when the wound is likely to suppurate (Lockwood). They further maintain that since a silk-worm suture may remain in the abdominal walls for three weeks with impunity, therefore a simple through-and-through suture of this material, that pierces all the layers of the belly wall, is all that is necessary to accurately adapt the various layers and hold them so that firm union can take place between the opposite sides of the incision, provided the silk gut is not tied so tightly as to cut through the tissues or strangulate them.

In inserting a through-and-through suture great care is to be taken to pierce the aponeurosis at least ½ inch from its edge; but the peritoneum must be taken up quite close to its edge, else the surplus portion will be forced in between the edges of the wound, and so tend to weaken the union.

They readily admit that the removal of sutures on or before the seventh day is absolutely wrong, as the uniting medium between the opposed surfaces is very easily separated, and it is owing to this early removal of the mass sutures, while the plastic lymph is still imperfectly organized, that we get a small percentage of herniæ.

They also condemn the use of silk, as used by Tait, for mass sutures, because it cannot be left in for more than a week without becoming infected.

Thus there is at present no unanimity either on the method of closing the abdominal wound, nor even on the materials to be employed for the sutures. Surgeons of great experience, such as Olshausen, Martin, Winter, Kelly, Pfannestiel, La Torre, and

* Noble had ten cases of late suppuration in 472 cases, while Lapton Smith had nine in 300 cases.

many others, affirm that the **layers** should each be sutured **separately.** Winter showed that herniæ occurred after Olshausen's operations in 22 per cent. of cases previous to the introduction of the buried suture of catgut, but the percentage fell to 8 per cent. after the buried suture was employed. Martin and La Torre have obtained similar results, and Kelly says that few of his patients now return with herniæ since he has employed the buried sutures of silver wire.

On the other hand, there are many supporters of the through-and-through suture, and Harrison Cripps, after having performed 1,000 sections, says: 'I have, except in fat patients, abandoned buried sutures, finding that, beside taking much longer to pass, I do not get nearly such good union as when all the coats were included together.'

When dealing with patients in whom there is a large deposit of fat in the abdominal walls, few, if any, operators maintain the superiority of the through-and-through suture; on the contrary, it is universally admitted that in these cases, at all events, the abdominal wound should be closed in layers. One of Abel's tables strikingly supports this view:

	Separate Fascial Suture per Cent.		Through-and-through Suture per Cent.
Patient with fatty layer 6 centimetres thick ...	25·0	...	75
,, ,, 4–6 ,, ,, ...	21·0	...	40
,, ,, 2½–4 ,, ,, ...	12·5	...	31
,, ,, 1½–2½ ,, ,, ...	8·0	...	22
,, ,, 1½ ,, ,, ...	2·4	...	29

We now come to consider the **influence of the abdominal belt.** Abel maintains that his statistics show that the wearing of an abdominal belt has nothing to do with preventing the formation of herniæ.

The following is his table to support his contention:

	Cases per Cent.		Hernia per Cent.
Bandage never worn	20	...	95
,, worn until 6th month ...	32	...	97
,, ,, 9th month ...	26	...	96
,, ,, 1 year	27	...	96
,, worn over 1 year	22	...	82
,, ,, 2 years	42	...	88
,, ,, 3 years	22	...	82
,, ,, 4 years	12	...	75

Although the bandage, or belt, is thus shown by Abel's table not to be a prophylactic, he nevertheless does not advise that it should be discarded, for it serves the purpose of at least preventing the increase in size of the hernia.

We have dealt with the wearing of the belt in another place; here we need only remark that we do not hesitate to say that the belt is a prophylactic measure of great importance.

Lastly, we need only mention that the length of time that the patient remains in bed is of importance, and while Martin allows his patients to rise about the tenth day, it is generally agreed that they should rest eighteen to twenty-one days. As we have mentioned elsewhere, in cases where patients have been allowed out of bed too soon the wound has given way altogether, and allowed the intestines to prolapse.

Operative Treatment of Post-Operative Hernia.—If the patient be suffering much pain or inconvenience from the hernia, we may advise an operation; but we should remember that there is no guarantee that the hernia will not return after the second operation. Of eleven cases operated on in the Leipzig clinic there were nine recurrences. Experience shows that the smaller the opening the less likelihood will there be of a return; while in all cases, even if the second operation does not cure, the patient's condition is much improved.

Hernia of the cicatrix, in its earlier stages, requires an operation; 'an incipient hernia of a cicatrix is not very serious, provided that it is carefully watched, the patient being intelligent and prompt to carry out the advice of her medical attendant' (Doran). Such herniæ may be kept back by careful bandaging, and we can control the size of the hernia by a well-fitted belt.

If, however, the patient begins to grow obese, she must be most careful, for the scar will yield from side to side and grow weak, and if there is a small hernial aperture present, the intra-abdominal pressure increases, and the omentum tends to dilate the sac, because the tension of the abdominal walls is increased; consequently the ring surrounding the opening into the sac is put on the stretch, and the return of the venous blood from the knuckle of omentum is hindered, while the arterial blood-supply is not diminished, and the omentum slowly swells, and more of the omentum is drawn into the sac, which thus becomes dilated.

If we determine to operate on a hernia we should thus proceed: The patient's skin is prepared with the utmost care. Before making the incision we should endeavour to return the contents of the sac into the abdominal cavity; but this will not always be possible, especially with large herniæ, where the omentum, and sometimes the bowel, adheres to the sac wall.

An elliptical incision is made which runs round the base of the tumour, but great care must be taken not to make a deep incision, lest the sac be entered at once, and the contents wounded.

The skin may be dissected off at once, and then it is well to make a second incision in the median line through the cicatricial covering of the sac, which consists of stretched cicatricial tissue, which is as tough as and not unlike a piece of white canvas. When this has been carefully incised we come on the extra-peritoneal fat and the sac of peritoneum, the walls of which are usually very much thickened, and we proceed to open this after seizing it with two catch forceps. The finger is introduced through the small opening, and we proceed to ascertain if the omentum or the bowel is adherent to the wall of the sac. The opening is now enlarged, and if we find bowel adhering, this is separated off, if possible, otherwise a piece of the sac is excised. In some cases it may be necessary, or advisable, to remove a large piece of omentum, and this should be done by employing the interlocking suture.* On no account is a large mass of omentum to be ligatured en masse.

The sac being now emptied, a large sponge with a cord attached is inserted into the peritoneal cavity, and spread out so as to shut off the omentum and intestines from the field of operation.

The next step is to separate the peritoneum from the cicatricial tissue and from around the entire rim formed by the edges of the recti muscles.

After this all the cicatricial tissue that surrounds the edge of the rim and covers the true aponeurosis of the rectus should be dissected away. When this has been done the aponeurosis of the rectus on either side should be split up close to the border of the hernial ring. This is most easily done by inserting the index-finger of the left hand under the muscle while the thumb

* In one case Lockwood had to insert as many as thirty interlocking sutures on removing the great omentum ('Hernia,' p. 218).

rests above, and a pair of angled scissors splits open the aponeurosis, and exposes the muscle below, care being taken not to cut the muscle, else the bleeding will be very sharp. The opposite side is now dealt with in the same way.

It is important to notice that at the upper angle of the oval rim there is usually a considerable interval between the recti

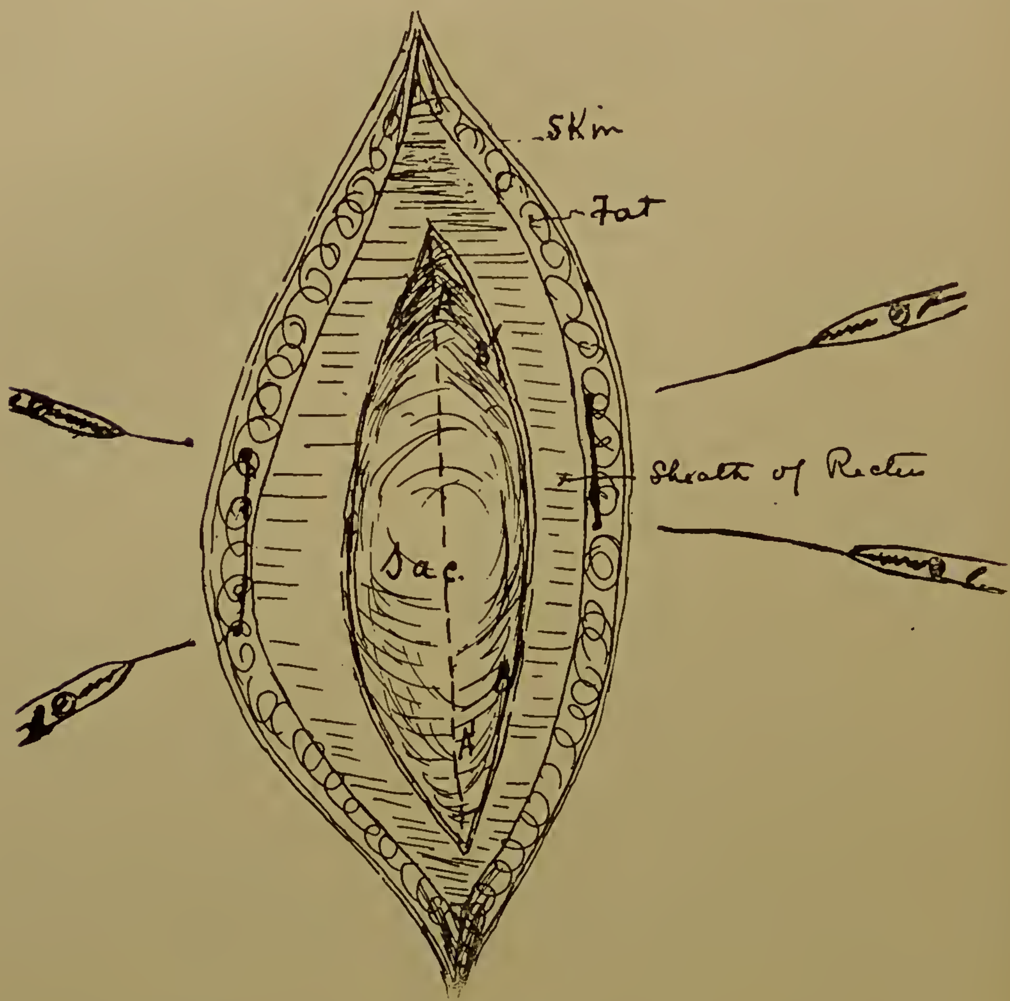

Fig. 132.

The skin and fat have been dissected away from the sheath of the rectus beneath: in the centre is the sac consisting of cicatricial tissue and peritoneum.

muscles, and this is bridged over by cicatricial tissue, which has become stretched, but which has not bulged very much. It is well to remove this, and to split the aponeurosis covering the muscles, so as to enable the edges to be firmly united.

The sponge being removed, the peritoneum* is now seized

* Much peritoneum should not be removed, for if much tension is put on it this membrane will split wherever the sutures are inserted.

with forceps, and pulled well up so as to be united by a continuous suture of catgut or wallaby tendon (Figs. 132 and 133).

To bring the aponeurosis of the rectus and the edges of the muscles into exact and firm apposition, we first seize the edges

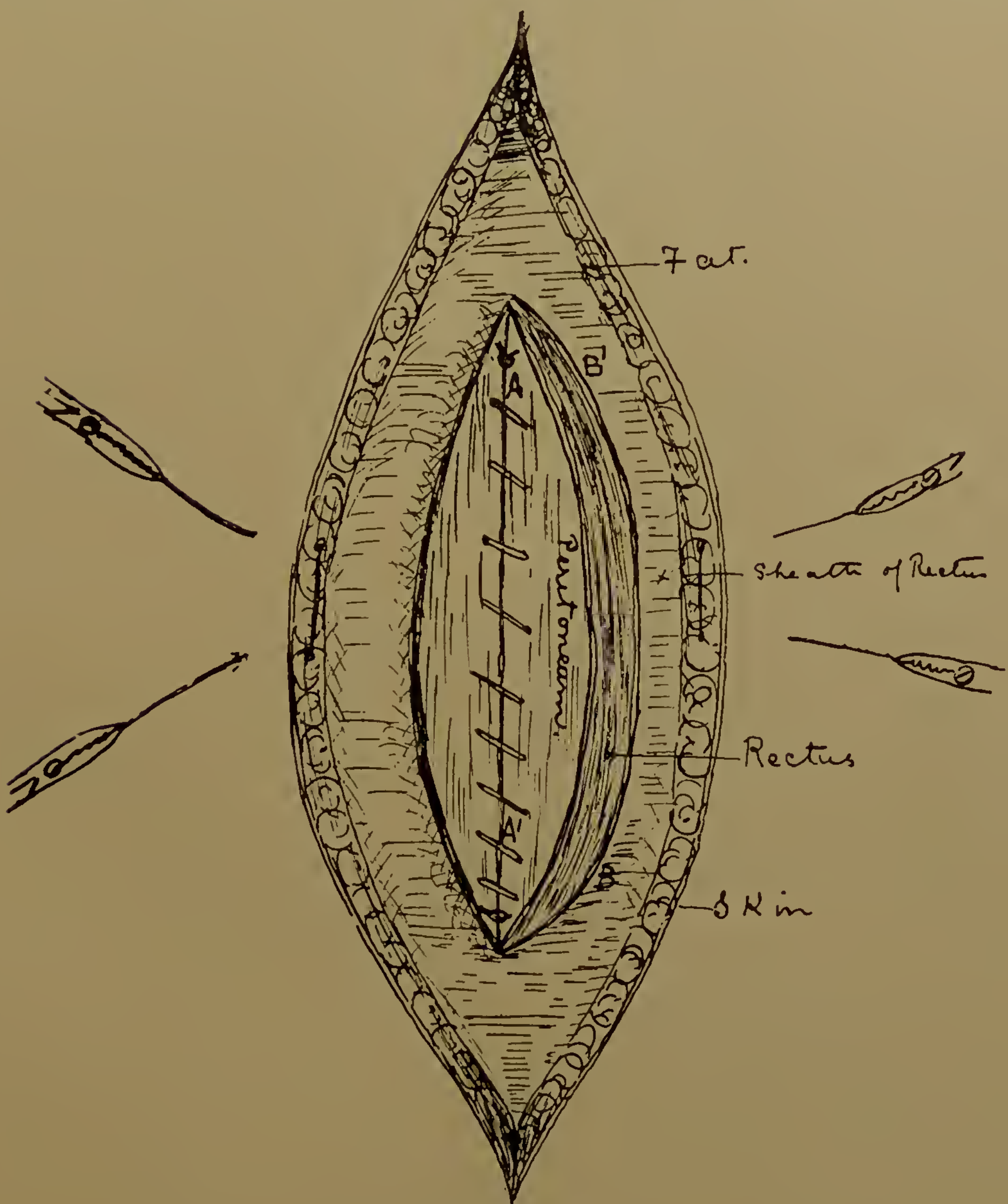

Fig. 133.

The sac of the hernia has been opened in the median line, the cicatricial tissue has been dissected away, the peritoneum has been united in the median line (A-A'). and the sheath of the rectus has been split open on one side (B-B').

of the aponeurosis in several places with catch forceps, and push back the overlying tissue so that we shall have at least $\frac{1}{2}$ inch of aponeurosis free (Fig. 133). Mattress sutures of chromic gut or silver wire are inserted through the rectus sheath $\frac{1}{2}$ inch

from the free edge, and then a little distance from the edge of the muscle, and then in the upper part (sternal end) of the wound, through the posterior layer of the rectus sheath, then out through the layers of the other side of the incision in the reverse order (Fig. 134).* When these have been inserted and tied

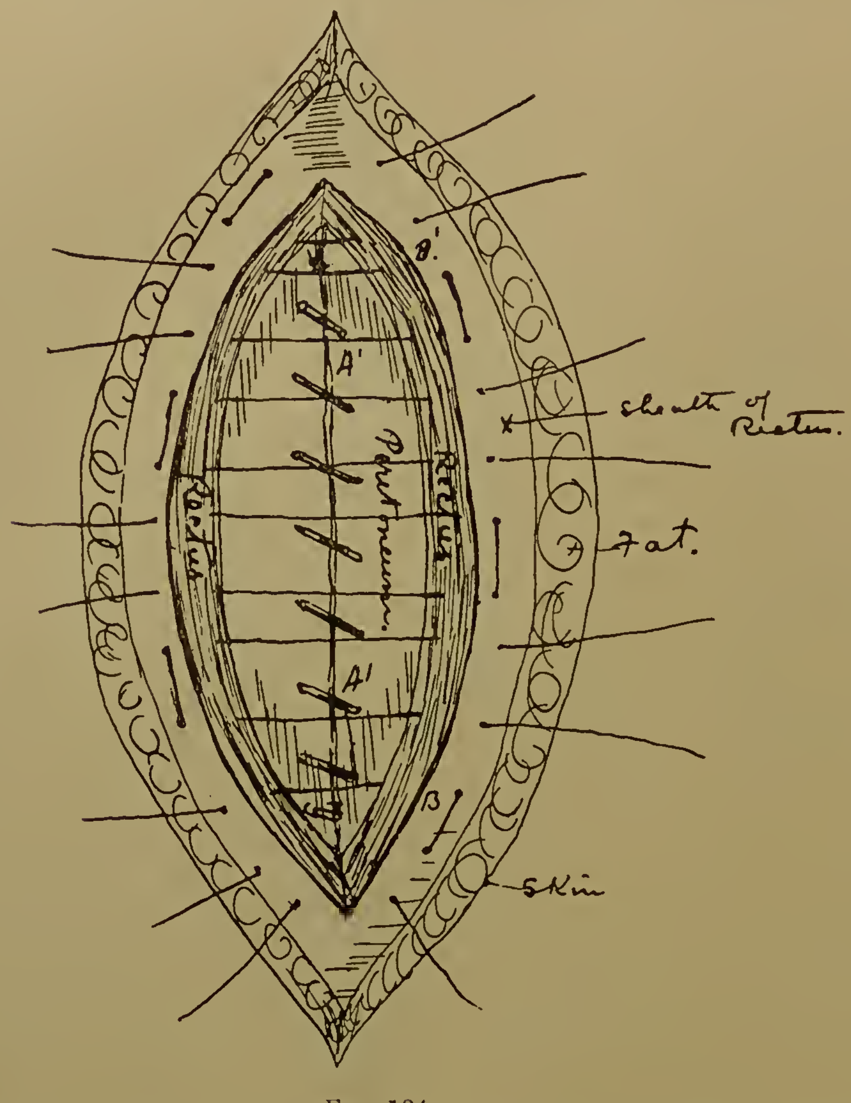

FIG. 134.

The peritoneum has been united in the median line; the sheath of the rectus has been split open on either side (B-B'); mattress sutures have been inserted through the sheath of the rectus and the rectus muscle.

we should take up the edges of the aponeurosis and insert some chromic-gut sutures, so as to leave no point ununited. The subcutaneous tissues are united if they are thick, and the skin

* If any difficulty is experienced in drawing the margins of the fascia together, the patient should be placed in a half-sitting posture (Bumm). We have tried this plan, and it is excellent.

edges are brought together by horsehair, or silkworm-gut, or by a subcuticular stitch.

The patient should rest in bed for one month after the operation, and should be ordered a well-fitting belt, and on leaving she should be warned against lifting heavy weights, moving furniture, or going to the washtub.

Occasionally the sac may be found sloughing.

Cripps records a case illustrating this complication. A patient, aged twenty-seven years, was admitted into hospital. Two years previously she had been operated upon for extra-uterine gestation. Two months later a ventral hernia had appeared, which had been gradually increasing in size.

On admission, when undressed, there was a sloughed hole about 2 inches in diameter. Through this about 6 inches of small intestine and some omentum protruded, and these were lying under the bandage and mixed up with cotton-wool. The sloughing skin, at the margin of the opening in the abdominal parietes, was cut away, and the edges of the opening sutured together ; no drainage. The patient recovered.

In conclusion, it may be mentioned that Greig Smith and others do not open the sac, but after separating the cicatricial tissue proceed at once to bring the edges of the recti together. There can be no objection to this procedure when the hernia is small, but it would be questionable surgery not to open the sac if we had any suspicion that the bowel or the omentum was adhering to it.

LIST OF AUTHORITIES

ERRATA.

Page 25, Fig. 22, *for* 'Poupinel' *read* 'Poupinet.'
Page 540, line 10, from foot, *for* 'Vaudrin' *read* 'Vautrin.'

INDEX

THE END

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